DOCUMENT RESUME

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IDENTIFIERS	Massachusetts Institute of Technology

ABSTRACT

The Massachusetts Institute of Technology provides a catalog of 16mm filmed and videotaped lectures and demonstrations. Each listing includes title, short description, length of presentation, catalog number, purchase and rental prices, and indications as to whether the item is film or videotape and black-and-white or color. The catalog is divided into 17 categories: artificial intelligence; calculus; colloid and surface chemistry; computer languages; digital signal processing; economics; engineering economy; friction, wear, and lubrication; introduction to experimentation; mechanics of polymer processing; modern control theory; network analysis and design; nonlinear vibrations; probability; random processes; thermostatics and thermodynamics; and special programs. Ordering information and forms are included. (LS)

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ED119723

Massachusetts Institute of Technology

16mm Film and Videotape Lectures and Demonstrations

1976/1977 Catalog

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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The Massachusetts Institute of Technology has developed more than 450 videotapes and 16 mm films on the sciences, mathematics, engineering, and management.

Produced at the Center for Advanced Engineering Study in cooperation with MIT and other faculty members, these programs were created as part of a self-study project for practicing engineers, industrial scientists, and technical managers.

Flexibly designed to meet individual learner needs, these lectures and demonstrations will be useful to industry and on-campus graduate and undergraduate classes.

Detailed study guides, including lecture notes, reading assignments, problem sets, and solutions accompany most of the subjects.

Descriptions of the films and videotapes follow. Please note the substantial discounts for complete set rental or purchase. Reservation forms are included to facilitate your ordering.

Artificial Intelligence	2
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IR 003 195

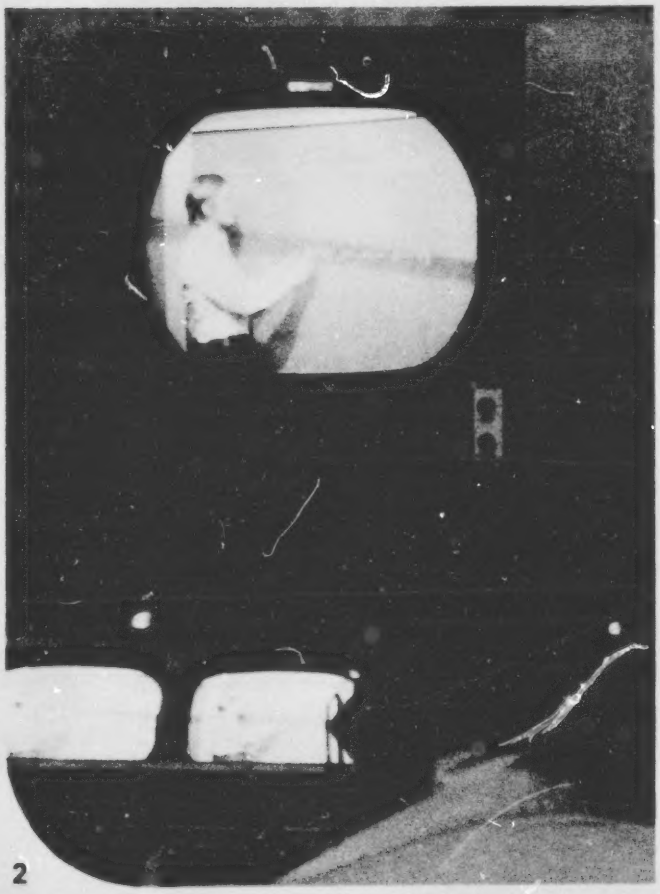
Artificial Intelligence

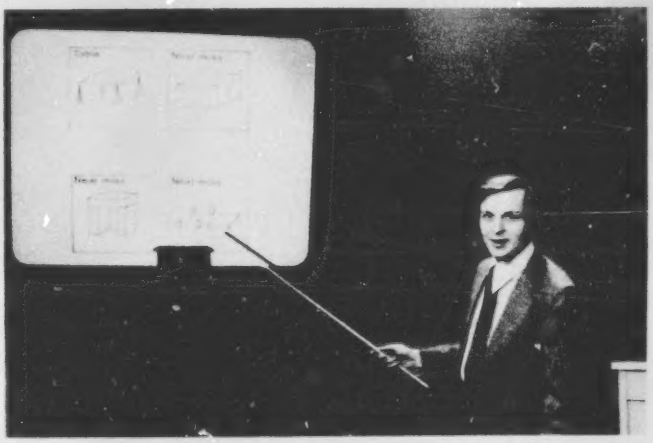
Patrick H. Winston

Artificial Intelligence is the science of making computers smart. It is practiced both by those who want to make computers more useful and by those who want to understand the nature of intelligence.

Intelligent systems will be better because they will know why something is wanted as well as what is wanted. But, making machines smart is also a new kind of psychology. Artificial Intelligence researchers believe that intelligence is the product of a family of qualities that can be studied abstractly and without concern for the particular hardware or "brainware" machines that manifest intelligence.

Patrick H. Winston is Associate Professor of Computer Science at MIT and Director of the MIT Artificial Intelligence Laboratory.





Artificial Intelligence

Twenty-four Color Videotapes

Geometric Analogy Problems (1)
Purposeful descriptions. Symbolic pattern matching. Descriptions of relations and transformations. Rule comparison.

26-min. Color Videotape
17-0101 Purchase $245 Rental $25.

Geometric Analogy Problems (2)
Geometric analogy examples. Remarks on improving performance. The role of analogy in identifying unknown objects.

20-min. Color Videotape
17-0102 Purchase $200 Rental $20.

The General Problem Solver
Using goals and subgoals. Difference descriptions, operators, and conditions. Iteration, recursion, and automatic backup. Traveling to Aunt Agatha's.

39-min. Color Videotape
17-0103 Purchase $325 Rental $33.

Solving Calculus Problems (1)
Goal trees and heuristic search. Judging difficulty and focusing attention. Strong and weak transformations.

25-min. Color Videotape
17-0104 Purchase $240 Rental $24.

Solving Calculus Problems (2)
Alternatives in performance measurement. Depth-first, breadth-first, and environment-driven search. Using programs as metaphors. The ephemeral quality of intelligence.

24-min. Color Videotape
17-0105 Purchase $230 Rental $23.

Perceptrons and Hill Climbing
The perceptron idea. The inability of perceptrons to recognize connectivity. Learning through parameter twiddling. Foothill, ridge, and plateau problems. The need for layers of information processing.

34-min. Color Videotape
17-0106 Purchase $300 Rental $30.

Picking The Next Move
The mini-max method of game playing. The alpha-beta speedup algorithm. Heuristic pruning. Static evaluation and plausible move generation.

39-min. Color Videotape
17-0107 Purchase $325 Rental $33.

Using Evidence
Remarks on strategy and tactics. Learning to play better. Linear scoring sums. Signature tables and layered signature tables.

25-min. Color Videotape
17-0108 Purchase $240 Rental $24.

Probing A New Domain
The problem of line drawing analysis. Combining regions into bodies. More evidence versus better evidence. Line drawing analysis as a research paradigm.

44-min. Color Videotape
17-0109 Purchase $350 Rental $35.

Exploiting Constraints
Identifying illegal drawings. Classification of lines and vertexes. Searching for compatible and vertex interpretations.

39-min. Color Videotape
17-0110 Purchase $325 Rental $33.

Working Out An Epistemology
Handling shadows and cracks. Using illumination information. Coping with small infinities. The metatheory of description refinement.

32-min. Color Videotape
17-0111 Purchase $285 Rental $29.

Learning
Description based learning of structures from samples. The importance of the near-miss. Model refinement using emphatic relations. Hypothesis and contradiction. Learning by discovery, from examples, and by being told.

28-min. Color Videotape
17-0112 Purchase $260 Rental $26.

Identifying Structures and Context
Computing relations between objects. Plain and fancy identification. Searching through similarity networks. Frame systems and contexts.

43-min. Color Videotape
17-0113 Purchase $345 Rental $35.

LISP Basics (1)
Basic numeric and symbol-manipulating primatives. Values and properties. The need for quoting. Predicates and conditionals. Defining new functions. Recursion.

20-min. Color Videotape
17-0114 Purchase $200 Rental $20.

LISP Basics (2)
Free and bound variables. MAPCAR, APPLY, and LAMBDA. Calculating the depth of an S-expression. Finding the mini-max value of a tree.

33-min. Color Videotape
17-0115 Purchase $290 Rental $29.

Differentiation in LISP
The identical form of programs and data. Constructing new S-expressions from pieces of old ones. Simplification on the fly. Intermediate expression bulge.

42-min. Color Videotape
17-0116 Purchase $340 Rental $34.

Building A Matching Language Using LISP
Storing and Retrieving information using property lists. Matching patterns against known facts. Storing facts in indexed directories.

34-min. Color Videotape
17-0117 Purchase $300 Rental $30.

Improving The Matching Function
Simultaneous matching and variable assignment. Matching pattern elements against strings. Restricted matching.

30-min. Color Videotape
17-0118 Purchase $275 Rental $28.

ARTIFICIAL INTELLIGENCE - Complete Set

Color Videotapes

Complete set of *twenty-four* color videotapes.

17-1100 Purchase $5825 (SAVE $940)
120 Day Rental $607 (SAVE $74)

Suggested Text

The Psychology of Computer Vision, edited by P. H. Winston, McGraw-Hill, 1975, 282 pp.

17-3100 Purchase $18 each.

Study Guide

Comments, photographs, references, problems, solutions. 182 pp. (One per student recommended.)

17-2100 Purchase $8.00 each. (10% Discount on five or more)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Working Algebra Word Problems
Translation of sentences into equations. Breaking up compound sentences. Retrieving library facts. The toy psychiatrist program.

41-min. Color Videotape
17-0119 Purchase $335 Rental $34.

Demons and Automatic Backup
The MICRO-PLANNER Language. Consequent, antecedant, and erasing subroutines. Looking for a fallible sinner.

21-min. Color Videotape
17-0120 Purchase $205 Rental $21.

Understanding English
The role of syntax, semantics, and deduction. The structure of noun groups. Translating noun groups into MICRO-PLANNER programs.

36-min. Color Videotape
17-0121 Purchase $310 Rental $31.

Effecting English Commands in the Blocks World
Goal oriented programming. The heterarchical approach. Putting the pyramid on the green block.

42-min. Color Videotape
17-0122 Purchase $340 Rental $34.

Constraint Structures
Sets of mutually exclusive features. Entry conditions. A 0th order theory of semantics. Bouncing the pointed ball.

23-min. Color Videotape
17-0123 Purchase $220 Rental $22.

Aspects of Natural Language Syntax
Context free and transformational grammars. Systemic grammar and feature driven analysis. Special purpose languages for dealing with syntax. Picking up a big red box.

31-min. Color Videotape
17-0124 Purchase $280 Rental $28.

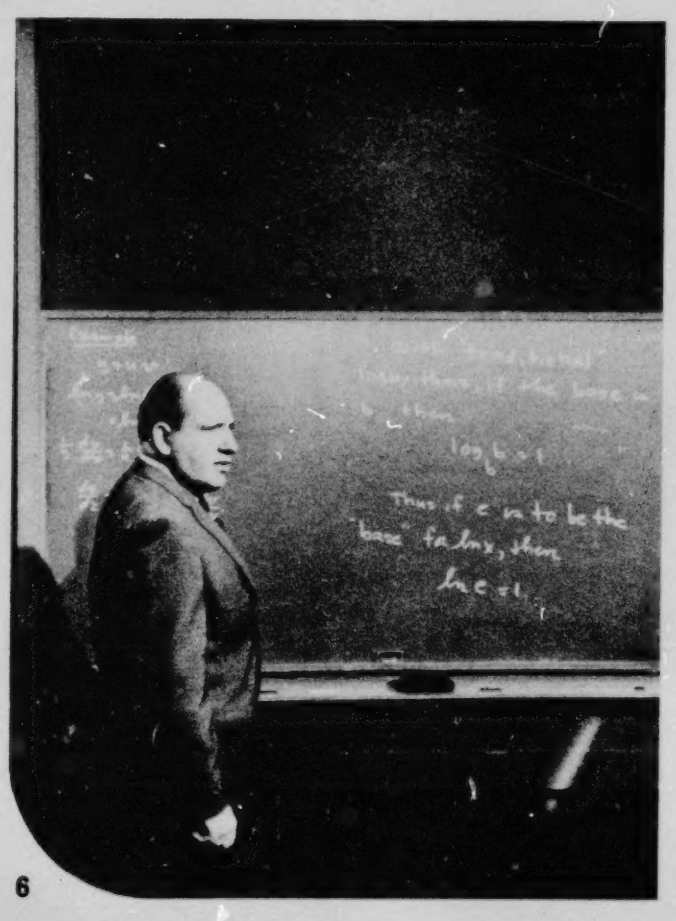
Calculus

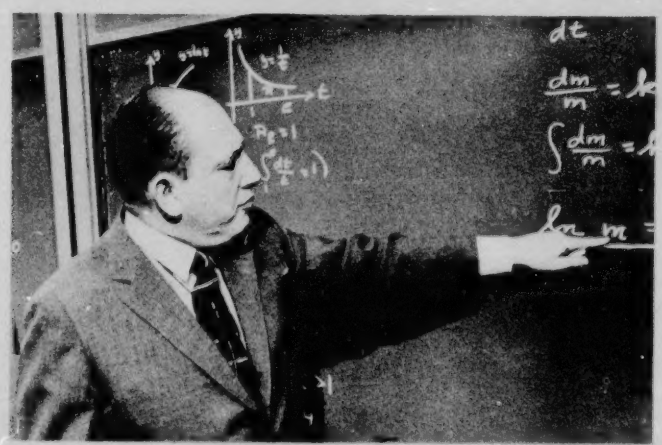
Herbert I. Gross

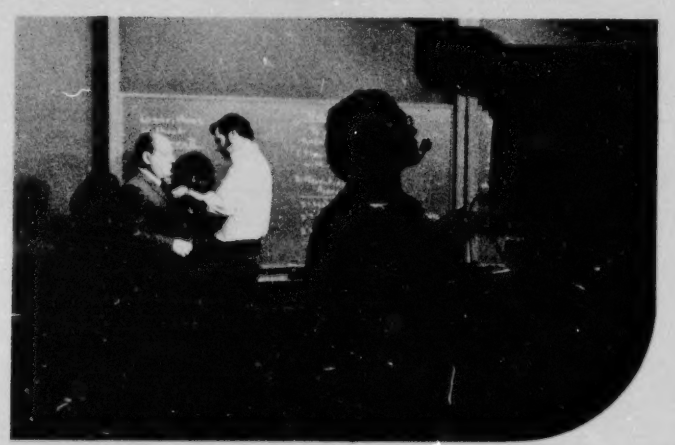
Calculus covers the material normally found in the first two years of a modern college sequence in calculus, differential equations, and linear algebra. The course begins with elementary set theory and other aspects of "new math" and continues with differential and integral calculus, circular and transcendental functions, and infinite series. The course then continues with vector arithmetic and vector calculus, partial derivatives, matrix algebra, and multiple integration. The final part of the course covers complex variables, differential equations, and linear algebra.

Designed originally as a refresher course (and, in fact, called Calculus "Revisited" when used at MIT), this material is suitable for all students with the requisite background.

Herbert I Gross was Senior Lecturer, Massachusetts Institute of Technology.







Calculus

Preface to Calculus
An introduction to calculus; the concept of 0/0; instantaneous speed; introduction to functions and graphs; the limit concept; area; general overview of calculus.

32-min. B&W Film or Videotape
26-0000 Purchase $215 Rental $22.

Sets, Functions, and Limits

Six B&W 16mm Films or Videotapes

Analytic Geometry
Cartesian coordinates; curves as sets of points; graphs of functions; equations of straight lines; simultaneous linear equations.

37-min. B&W Film or Videotape
26-0101 Purchase $240 Rental $24.

Functions
Notations; concepts of onto and one-to-one; the arithmetic of functions of a real variable; intervals and deleted neighborhoods; absolute values; composition of functions.

39-min. B&W Film or Videotape
26-0102 Purchase $255 Rental $2[illegible].

Inverse Functions, "Switch in Emphasis"
The concept of an inverse function; some examples; graphical interpretation; single-valued and multi-valued functions; a discussion of branches of functions.

40-min. B&W Film or Videotape
26-0103 Purchase $260 Rental $26.

SETS, FUNCTIONS, AND LIMITS - Complete Set

Films/Videotapes

Complete set of *six* B&W 16 mm films or videotapes

26-1100 Purchase $1600 (SAVE $140)
30 Day Rental $166 (SAVE $10)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text, covering "new math" concepts and expanding on difficult topics in Calculus of a Single Variable. 346 pp.

26-4000 Purchase $11.00 each.

Study Guide

Pretest, reading assignments, problems, solutions, quiz. 184 pp. (One per student recommended.)

26-2100 Purchase $6.00 each. (10% Discount on five or more.)

Lecture Notes

A set of chalkboard photographs for all the films/videotapes on Calculus of a Single Variable. 82 pp.

26-5000 Purchase $4.50 each.

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes, Suggested Text, and Supplementary Notes.

Derivatives and Limits
Instantaneous speed as an outgrowth and refinement of average speed; definition of limit; instantaneous speed as a limit; the formal definition of limit and some consequences.

45-min. B&W Film or Videotape
26-0104 Purchase $285 Rental $29.

A More Rigorous Approach to Limits
A continuation of the previous lecture; important limit properties are developed as theorems from the formal definition of limit.

46-min. B&W Film or Videotape
26-0105 Purchase $290 Rental $29.

Mathematical Induction
The meaning of mathematical induction; some examples of what mathematical induction is and isn't; applications to limit theorems.

29-min. B&W Film or Videotape
26-0106 Purchase $195 Rental $20.

Differentation

Eleven B&W 16mm Films or Videotapes

Derivatives of Some Simple Functions
Definition of derivative; the derivative of x^n where n is an integer; derivatives of sums, differences, products, and quotients.

28-min. B&W Film or Videotape
26-0201 Purchase $190 Rental $20.

Approximations and Infinitesimals
Approximating Δy by $f'(x)\Delta x$; discussion of the difference between Δy and $f'(x)\Delta x$; some examples; introduction to the chain rule.

34-min. B&W Film or Videotape
26-0202 Purchase $225 Rental $23.

Composite Functions and the Chain Rule
Composition of functions; a graphical interpretation; applications to parametric equations; using the chain rule to extend our concept of finding derivatives.

39-min. B&W Film or Videotape
26-0203 Purchase $255 Rental $26.

DIFFERENTIATION - Complete Set

Films/Videotapes

Complete set of *eleven* B&W 16 mm films or videotapes.

26-1200 Purchase $2135 (SAVE $240)
55 Day Rental $230 (SAVE $17)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text, covering "new math" concepts and expanding on difficult topics in Calculus of a Single Variable. 346 pp.

26-4000 Purchase $11.00 each.

Study Guide

Pretest, reading assignments, problems, solutions, quiz. 268 pp. (One per student recommended.)

26-2200 Purchase $8.50 each. (10% Discount on five or more).

Lecture Notes

A set of chalkboard photographs for all the films/videotapes on Calculus of a Single Variable. 82 pp.

26-5000 Purchase $4.50 each.

A Complete Self-Study Subject. The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes, Suggested Text, and Supplementary Notes

Differentiation of Inverse Functions
The concept of an inverse function; differentiation of an inverse function; when is a function invertible?

28-min. B&W Film or Videotape
26-0204 Purchase $190 Rental $20.

Implicit Differentiation
Finding the derivative when the functional relationship is implied [that is, when it has the form $f(x,y) = 0$]; application to the case of x^n where n is a rational number; the use of implicit differentiation in the study of related rates.

40-min. B&W Film or Videotape
26-0205 Purchase $260 Rental $26.

Continuity
Physical interpretation of continuity; the definition of continuity in terms of limits; a geometric interpretation of continuity; some applications of continuity to equation solving; some analytic consequences of definition of continuity.

22-min. B&W Film or Videotape
26-0206 Purchase $150 Rental $20.

Curve Plotting
Basic pre-calculus review; even and odd functions and other symmetries; the role of the first and second derivatives in curve plotting; stationary points; inflections; some examples.

31-min. B&W Film or Videotape
26-0207 Purchase $210 Rental $21.

Maxima and Minima
High and low points of a curve; techniques for finding these high and low points; applications to finding maxima and minima of functions; some physical applications.

34-min. B&W Film or Videotape
26-0208 Purchase $225 Rental $23.

Rolle's Theorem and its Consequences
Statement of Rolle's Theorem; a geometric interpretation; some cautions; the Mean Value Theorem; consequences of the Mean Value Theorem.

30-min. B&W Film or Videotape
26-0209 Purchase $205 Rental $21.

Inverse Differentiation
The "Opposite" of differentiation; trying to find $f(x)$ knowing $f'(x)$; some examples; some formulas; notation.

42-min. B&W Film or Videotape
26-0210 Purchase $270 Rental $27.

The "Definite" Indefinite Integral

The meaning of $\int_a^b f(x)\,dx$ as $g(b) - g(a)$ where $g'(x) = f(x)$; some applications.

29-min. B&W Film or Videotape
26-0211 Purchase $195 Rental $20.

The Circular Functions

Two B&W 16mm Films or Videotapes

Circular Functions
Trigonometric functions without the use of angles; the logic of radian measure; the definition of circular functions; the derivative of sin x and cos x.

35-min. B&W Film or Videotape
26-0301 Purchase $230 Rental $23.

Inverse Circular Functions
Meaning of arcsin x in terms of the sine function; the derivative of arcsin x in terms of the derivative of sin x; some applications.

26-min. B&W Film or Videotape
26-0302 Purchase $175 Rental $20.

Study Guide

Pretest, reading assignments, problems, solutions, quiz. 96 pp. (One per student recommended.)

26-2300 Purchase $4.00 each. (10% Discount on five or more.)

The Definite Integral

Four B&W 16mm Films or Videotapes

The Definite Integral
Axiomatic approach to area; area approximations by upper and lower bounds; the method of exhaustion; using limits to find areas of non-rectilinear regions; piecewise continuity; trapezoidal approximations.

36-min. B&W Film or Videotape
26-0401 Purchase $235 Rental $24.

Marriage of Differential and Integral Calculus
First Fundamental Theorem of Integral Calculus, some applications; Second Fundamental Theorem of Integral Calculus; some applications; significance of the two theorems.

30-min. B&W Film or Videotape
26-0402 Purchase $205 Rental $21.

3-Dimensional Area
Extending the axioms of area to volume; some applications; the method of cylindrical shells.

42-min. B&W Film or Videotape
26-0403 Purchase $270 Rental $27.

1-Dimensional Area
The main difference between arclength and either area or volume; the limit definition of arclength; some philosophical and practical questions concerning the definition; approximating errors and their magnitude when we use infinite sums.

36-min. B&W Film or Videotape
26-0404 Purchase $235 Rental $24.

Transcendental Functions

Four B&W 16mm Films or Videotapes

Logarithms without Exponents
The concept of the natural logarithm; the notion of the rate of change being proportional to the amount present; the general concept of a logarithmic function; the study of ln x in terms of differential calculus; the study of ln x in terms of integral calculus; the meaning of the number e as the base of the natural logarithms.

34-min. B&W Film or Videotape
26-0501 Purchase $225 Rental $23.

THE DEFINITE INTEGRAL - Complete Set

Films/Videotapes

Complete set of *four* B&W 16 mm Films or Videotapes.

26-1400 Purchase $870 (SAVE $75)
20 Day Rental $ $86 (SAVE $10)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text, covering "new math" concepts and expanding on difficult topics in Calculus of a Single Variable 346 pp.

26-4000 Purchase $11.00 each.

Study Guide

Pretest, reading assignments, problems, solutions, quiz. 128 pp. (One per student recommended.)

26-2400 Purchase $4.00 each. (10% Discount on five or more.)

Lecture Notes

A set of chalkboard photographs for all the films/videotapes on Calculus of a Single Variable. 82 pp.

26-5000 Purchase $4.50 each.

A Complete Self-Study Subject. The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes, Suggested Text, and Supplementary Notes.

Inverse Logarithms

The invertibility of the logarithmic function; e^x as the inverse of ln x; a discussion of exponential functions; some applications.

21-min. B&W Film or Videotape
26-0502 Purchase $145 Rental $20.

What a Difference a Sign Makes

Hyperbolic functions in terms of the hyperbola $x^2-y^2=1$; comparisons with the circular functions; the relationship between hyperbolic functions and exponential functions; applications of calculus to hyperbolic functions.

27-min. B&W Film or Videotape
26-0503 Purchase $180 Rental $20.

Inverse Hyperbolic Functions

The theory of inverse functions applied to the hyperbolic functions; some formulas for differentiation and integration; some applications.

30-min. B&W Film or Videotape
26-0504 Purchase $205 Rental $21.

More Integration Techniques

Four B&W 16mm Films or Videotapes

Some Basic Recipes

A review and extension of previous results for finding f(x) knowing f'(x); particular emphasis is placed on the case where f'(x) involves the sum and/or difference of two squares; completing the square.

30-min. B&W Film or Videotape
26-0601 Purchase $205 Rental $21.

Partial Fractions

The concept of partial fractions; finding f(x) when f'(x) is the quotient of two polynomials; some notes about identities; application of partial fractions to the case where f is of the form f(sin x, cos x).

32-min. B&W Film or Videotape
26-0602 Purchase $215 Rental $22.

TRANSCENDENTAL FUNCTIONS - Complete Set

Films/Videotapes

Complete set of *four* B&W 16 mm films or videotapes

26-1500 Purchase $695 (SAVE $60)
20 Day Rental $74 (SAVE $10)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text, covering "new math" concepts and expanding on difficult topics in Calculus of a Single Variable. 346 pp.

26-4000 Purchase $11.00 each.

Study Guide

Pretest, reading assignments, problems, solutions, quiz. 90 pp. (One per student recommended.)

26-2500 Purchase $4.00 each. (10% Discount on five or more.)

Lecture Notes

A set of chalkboard photographs for all the films/videotapes on Calculus of a Single Variable. 82 pp.

26-5000 Purchase $4.50 each.

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes, Suggested Text, and Supplementary Notes.

Integration by Parts
Using the identity $d(uv) = udv + vdu$ to find $\int udv$ knowing $\int vdu$; using the technique to evaluate certain integrals; reduction formulas; some applications.

26-min. B&W Film or Videotape
26-0603 Purchase $175 Rental $20.

Improper Integrals
The problem of trying to study $\int_a^b f(x)dx$ when $f(x)$ is not continuous on the interval $[a,b]$; some examples; what happens if the limits of integration are not finite; importance of improper integrals.

29-min. B&W Film or Videotape
26-0604 Purchase $195 Rental $20.

Infinite Series

Six B&W 16mm Films or Videotapes

Many Versus Infinite
Discussion of how infinity differs from "very large"; some subtle and not subtle consequences of the difference; the case against intuition; motivating infinite series in terms of finding area as a limit.

26-min. B&W Film or Videotape
26-0701 Purchase $175 Rental $20.

Positive Series
The special case wherein each term in the series is non-negative; the concept of convergence; the comparison test; the ratio test; the integral test.

34-min. B&W Film or Videotape
26-0702 Purchase $225 Rental $23.

MORE INTEGRATION TECHNIQUES - Complete Set

Films/Videotapes

Complete set of *four* B&W 16 mm films or videotapes.

26-1600 Purchase $725 (SAVE $65)
20 Day Rental $73 (SAVE $10)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text, covering "new math" concepts and expanding on difficult topics in Calculus of a Single Variable. 346 pp.

26-4000 Purchase $11.00 each.

Study Guide

Pretest, reading assignments, problems, solutions, quiz. 80 pp. (One per student recommended.)

26-2600 Purchase $4.00 each. (10% Discount on five or more.)

Lecture Notes

A set of chalkboard photographs for all the films/videotapes on Calculus of a Single Variable. 80 pp.

26-5000 Purchase $4.50 each.

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes, Suggested Text, and Supplementary Notes.

Absolute Convergence
Discussion of non-absolute convergence; conditional and absolute convergence; the subtlety of a series converging when each of its negative terms is replaced by the absolute value of that term; some consequences of absolute convergence; geometric interpretation.

21-min. B&W Film or Videotape
26-0703 Purchase $145 Rental $20.

Polynomial Approximations
Using an nth degree polynomial to approximate a function f(x); how to choose the coefficients of the polynomial to get the "best" approximation; the notion of a power series; interval of convergence of a power series; Taylor's Remainder Theorem; expressing functions in terms of power series.

32-min. B&W Film or Videotape
26-0704 Purchase $215 Rental $22.

Uniform Convergence
A discussion of pointwise convergence versus uniform convergence; some important consequences of uniform convergence; applications of uniform convergence to the study of power series.

28-min. B&W Film or Videotape
26-0705 Purchase $190 Rental $20.

Uniform Convergence of Power Series
The topics introduced in the previous lecture are extended here. In particular the Weirstrass M-test is introduced and discussed; using power series to evaluate definite integrals when we do not know the anti-derivative of the integrand.

27-min. B&W Film or Videotape
26-0706 Purchase $180 Rental $20.

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Complete set of *six* B&W 16 mm films or videotapes.

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Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text, covering "new math" concepts and expanding on difficult topics in Calculus of a Single Variable. 346 pp.

26-4000 Purchase $11.00 each.

Study Guide

Pretest, reading assignments, problems, solutions, quiz. 178 pp. (One per student recommended.)

26-2700 Purchase $6.00 each. (10% Discount on five or more.)

Lectures Notes

A set of chalkboard photographs for all the films/videotapes on Calculus of a Single Variable. 80 pp.

26-5000 Purchase $4.00 each.

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes, Suggested Text, and Supplementary Notes.

Vector Arithmetic

Six B&W 16mm Films or Videotapes

The "Game" of Mathematics
The generalized definition of a game; mathematics as a "game"; mathematical structure viewed as a "game".

20-min. B&W Film or Videotape
27-0101 Purchase $140 Rental $20.

"Arrow" Arithmetic
Definition of a vector; vectors as directed lengths (arrows); Addition of vectors (the resultant); i and j components; an introduction to vector arithmetic in terms of mathematical structure.

28-min. B&W Film or Videotape
27-0102 Purchase $190 Rental $20.

3-Dimensional Vectors
Generalization from 2-dimensional space to 3-dimensional space; i,j, and k components of vectors; vector arithmetic in 3-dimensional Cartesian coordinates; other coordinate systems; vector properties versus coordinate properties.

26-min. B&W Film or Videotape
27-0103 Purchase $175 Rental $20.

The Dot Product
Physical motivation in terms of "work"; the geometric definition; computing the dot product in Cartesian coordinates; the mathematical structure of the dot product; geometric applications to finding angles and length projections.

29-min. B&W Film or Videotape
27-0104 Purchase $195 Rental $20.

The Cross Product
Geometric definition; the structure of the cross product; computing the cross product in Cartesian coordinates; using determinant notation to compute the cross product; geometric applications of the cross product to finding areas and lines perpendicular to planes.

31-min. B&W Film or Videotape
27-0105 Purchase $210 Rental $21.

Equations of Lines and Planes
Vector methods for finding the equation of a line in 3-space; finding the equation of a plane in terms of vectors; some examples.

28-min. B&W Film or Videotape
27-0106 Purchase $190 Rental $20.

VECTOR ARITHMETIC - Complete Set

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Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text introducing the concept of mathematical structure and expanding on difficult topics in Calculus of Several Variables. 182 pp.

27-4000 Purchase $5.00 each.

Study Guide

Pretest, chalkboard photographs, reading assignments, problems, solutions, quiz. 173 pp. (One per student recommended.)

27-2100 Purchase $5.50 each. (10% Discount on five or more).

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Suggested Text, and Supplementary Notes.

Vector Calculus

Four B&W 16mm Films or Videotapes

Vector Functions of a Scalar Variable
The concept of "operating" on a number to produce a vector; force as a function of time; limit theorems; the derivative of a vector function of a scalar variable; some formulas for finding derivatives; application to motion in a plane.

38-min. B&W Film or Videotape
27-0201 Purchase $250 Rental $25.

Tangential and Normal Vectors
The position vector; the unit tangent vector; the unit normal vector; the concept of curvature and radius of curvature; the torsion vector in 3-dimensional space.

28-min. B&W Film or Videotape
27-0202 Purchase $190 Rental $20.

Polar Coordinates
Definition of polar coordinates; the relationship between polar and Cartesian coordinates; polar equations for curves; slope and area in terms of polar coordinates.

30-min. B&W Film or Videotape
27-0203 Purchase $205 Rental $21.

Vectors in Polar Coordinates
The basis vectors in polar coordinates; the need for using polar coordinates in some vector problems; the position vector, the velocity vector, and the acceleration vector in polar coordinates; applications to a central force field.

27-min. B&W Film or Videotape
27-0204 Purchase $180 Rental $20.

VECTOR CALCULUS - Complete Set

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Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text introducing the concept of mathematical structure and expanding on difficult topics in Calculus of Several Variables. 182 pp.

27-4000 Purchase $5.00

Study Guide

Pretest, chalkboard photographs, reading assignments, problems, solutions, quiz. 212 pp. (One per student recommended.)

27-2200 Purchase $7.00 each. (10% Discount on five or more).

A Complete Self-Study Subject. The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Suggested Text, and Supplementary Notes.

Partial Derivatives

Six B&W 16mm Films or Videotapes

n-Dimensional Vector Spaces
The concept of a vector as the independent variable; a scalar function of a vector variable; the structure of an n-dimensional vector space; an example of a 4-dimensional vector space; generalizing the concepts of distance and limits to n-dimensional vector spaces.

32-min. B&W Film or Videotape
27-0301 Purchase $215 Rental $22.

Calculus of Several Variables
The special case of 2 independent variables; a geometric interpretation; the concept of a partial derivative; some special cautions; the partial derivative in terms of "slices" of a surface; the concept of a tangent plane to a surface.

35-min. B&W Film or Videotape
27-0302 Purchase $230 Rental $23.

Directional Derivatives
Motion in a direction other than parallel to either the x- or y-axis; the definition of a directional derivative in terms of Cartesian coordinates; the gradient vector; the tangent plane; some examples of directional derivatives.

33-min. B&W Film or Videotape
27-0303 Purchase $220 Rental $22.

The Chain Rule
Generalizing the Chain Rule to a function of several real variables; using the chain rule to find higher order derivatives; some examples.

38-min. B&W Film or Videotape
27-0304 Purchase $250 Rental $25.

Integrals Involving Parameters
Physical motivation; geometric interpretation; differentiating $\int_a^b f(x,y)\,dy$; variable limits of integration; some subtleties.

27-min. B&W Film or Videotape
27-0305 Purchase $180 Rental $20.

PARTIAL DERIVATIVES - Complete Set

Films/Videotapes

Complete set of *six* B&W 16 mm films and videotapes

27-1300 Purchase $1185 (SAVE $105)
30 Day Rental $122 (SAVE $10)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text introducing the concept of mathematical structure and expanding on difficult topics in Calculus of Several Variables. 132 pp.

27-4000 Purchase $5.00 each.

Study Guide

Pretest, chalkboard photographs, reading assignments, problems, solutions, quiz. 306 pp. (One per student recommended.)

27-2300 Purchase $10.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Suggested Text, and Supplementary Notes.

Exact Differentials
The differential of f(x,y); the definition of the total differential; the meaning of an exact differential; applications to equations of the form f(x,y)=0

29-min. B&W Film or Videotape
27-0306 Purchase $195 Rental $20.

Matrix Algebra

Five B&W 16mm Films or Videotapes

Linearity Revisited
Properties of linear functions; the concept of "locally" linear using the linear part of w to study w = f(x,y) in "small" neighborhoods; systems of linear equations; matrix notation motivating matrix multiplication.

47-min. B&W Film or Videotape
27-0401 Purchase $300 Rental $30.

The "Game" of Matrices
n by n matrices; defining equality of two matrices; adding two matrices; structural properties of matrix arithmetic; some differences between matrix and numerical arithmetic; non-singular matrices; introduction to matrix algebra; using determinants to study non-singular matrices.

41-min. B&W Film or Videotape
27-0402 Purchase $265 Rental $27.

Inverting a Matrix
Finding the inverse of a non-singular matrix; interpretation in terms of matrix algebra, functions, and geometry; discussion of when a matrix is singular how to determine whether a matrix can be inverted.

45-min. B&W Film or Videotape
27-0403 Purchase $285 Rental $29.

Inverting More General Systems of Equations
A review of inverting linear systems; inverting more general (i.e., non-linear) systems; the Jacobian; some examples; discussion of various pitfalls.

28-min. B&W Film or Videotape
27-0404 Purchase $190 Rental $20.

MATRIX ALGEBRA - Complete Set

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Complete set of *five* B&W 16 mm films or videotapes

27-1400 Purchase $1165 (SAVE $100)
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Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text introducing the concept of mathematical structure and expanding on difficult topics in Calculus of Several Variables. 182 pp.

27-4000 Purchase $5.00 each.

Study Guide

Pretest, chalkboard photographs, reading assignments, problems, solutions, quiz. 262 pp. (One per student recommened.)

27-2400 Purchase $8.50 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
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Maxima and Minima in Several Variables
The meaning of relative maxima and and minima in the study of real-valued functions of several real variables; how to test for such values; a geometric interpretation; constraints and the use of the chain rule.

34-min. B&W Film or Videotape
27-0405 Purchase $225 Rental $23.

Multiple Integration

Five B&W 16mm Films or Videotapes

Double Multiple Sums
Physical motivation in terms of variable density; geometric interpretation; application to finding the mass of a square plate; upper and lower bounds; generalization; multiple sum notation limits involving multiple sums.

30-min. B&W Film or Videotape
27-0501 Purchase $205 Rental $21.

The Fundamental Theorem
The anti-derivative in several variables; some examples; a geometric interpretation in term of areas; computing limits of certain infinite double sums by means of the anti-derivative and conversely.

26-min. B&W Film or Videotape
27-0502 Purchase $175 Rental $20.

Multiple Integration and the Jacobian
A review of the definite integral and change of variable; an example; the problem when we deal with more than one independent variable; mapping a region of the xy-plane into a region in the uv-plane; the role of the Jacobian in change of variable problems involving multiple integration.

33-min. B&W Film or Videotape
27-0503 Purchase $220 Rental $22.

Introduction to Line Integrals
The definition of a line integral; distinguishing a line integral from a double integral; some examples; some general properties of line integrals; viewing the line integral as a definite integral.

24-min. B&W Film or Videotape
27-0504 Purchase $165 Rental $20.

MULTIPLE INTEGRATION - Complete Set

Films/Videotapes

Complete set of *five* B&W 16 mm films or videotapes

27-1500 Purchase $945 (SAVE $80)
25 Day Rental $99 (SAVE $10)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text introducing the concept of mathematical structure and expanding on difficult topics in Calculus of Several Variables. 182 pp.

27-4000 Purchase $5.00 each.

Study Guide

Pretest, chalkboard photographs, reading assignments, problems, solutions, quiz. 290 pp. (One per student recommended.)

27-2500 Purchase $9.50 each.
(10% Discount on five or more.)

A Complete Self-Study Subejct.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Suggested Text, and Supplementary Notes.

Green's Theorem
A discussion of simply-connected regions; the statement of Green's Theorem; an outline of the proof; some comments about the theorem showing how line integrals may be related to multiple integrals; some examples; applying Green's Theorem to regions which are not simply-connected.

40-min. B&W Film or Videotape
27-0505 Purchase $260 Rental $26.

Complex Variables

Five B&W 16mm Films or Videotapes

The Complex Numbers
Development of the real numbers; complex numbers as a natural outgrowth of the real numbers; arithmetical structure; polar coordinates and complex numbers; applications; DeMoivre's Theorem; extracting the nth roots of a number.

43-min. B&W Film or Videotape
28-0101 Purchase $275 Rental $28.

Functions of a Complex Variable
Rules which assign complex numbers to other complex numbers; a geometric interpretation; an analytic and graphical introduction to limits; derivatives of complex functions; Laplace's equation.

35-min. B&W Film or Videotape
28-0102 Purchase $230 Rental $23.

Conformal Mappings
Review of mappings of the xy-plane into the uv-plane; the definition of a conformal mapping; applications; conformal mapping in the study of Laplace's equation; boundary value problems.

36-min. B&W Film or Videotape
28-0103 Purchase $235 Rental $24.

Sequences and Series
The concept of sequences and series applied to complex numbers; a pictorial interpretation; defining sin z, log z, etc. in terms of convergent power series; application to series of real numbers; interval of convergence.

33-min. B&W Film or Videotape
28-0104 Purchase $220 Rental $22.

COMPLEX VARIABLES - Complete Set

Films/Videotapes

Complete set of *five* B&W 16 mm films or videotapes

28-1100 Purchase $1090 (SAVE $95)
25 Day Rental $110 (SAVE $10)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text, providing background information on number systems and expanding on the concepts of linear independence and differential operators. 92 pp.

28-4000 Purchase $4.00 each.

Study Guide

Pretest, chalkboard photographs reading assignments, problems, solutions, quiz. 370 pp. (One per student recommended.)

28-2100 Purchase $12.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Suggested Text, and Supplementary Notes.

Integrating Complex Functions
A review of the definite integral; extending the results to the case of complex numbers; line integrals; integrating analytic functions; integrals along closed curves.

34-min. B&W Film or Videotape
28-0105 Purchase $225 Rental $23.

Differential Equations

Seven B&W 16mm Films or Videotapes

The Concept of a General Solution
Given f(x,y,y') does the equation have a solution and if so is the solution unique? Some examples. Clairaut's Equation. The definition of a general solution. Application to certain first degree differential equations. More on exact differentials.

34-min. B&W Film or Videotape
28-0201 Purchase $225 Rental $23.

Linear Differential Equations
Examples of non-linear differential equations; the definition of a linear differential equation; some examples; properties of linear equations; finding the general solution of a linear differential equation.

35-min. B&W Film or Videotape
28-0202 Purchase $230 Rental $23.

Solving the Linear Equation L(y) = 0; Constant Coefficients
Trying for solutions in the form $y = e^{rx}$; the problems involved with r being a non-real number; the general concept of the reduced or homogeneous equation; what happens if r is a repeated root of the auxiliary equation; some examples.

19-min. B&W Film or Videotape
28-0203 Purchase $130 Rental $20.

DIFFERENTIAL EQUATIONS - Complete Set

Films/Videotapes

Complete set of *seven* B&W 16 mm films or videotapes

28-1200 Purchase $1300 (SAVE $115)
35 Day Rental $143 (SAVE $10)

Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

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Supplementary Notes

A supplement to the text, providing background information on number systems and expanding on the concepts of linear independence and differential operators. 92 pp.

28-4000 Purchase $4.00 each.

Study Guide

Pretest, chalkboard photographs reading assignments, problems, solutions, quiz. 458 pp. (One per student recommended.)

28-2200 Purchase $15.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Suggested Text, and Supplementary Notes.

Undetermined Coefficients
Find a solution of L(y) = f(x) in the special case that the coefficients are still constants and f(x) is either a polynomial, an exponential function, or a function of the form sin mx or cos mx. The meaning of undetermined coefficients; the role of the reduced equation; the method of guessing a trial solution. Some applications.

29-min. B&W Film or Videotape
28-0204 Purchase $195 Rental $20.

Variation of Parameters
A method for handling L(y) = f(x) for any linear equation and more general categories for f(x); the derivation of the technique; how the technique is used; some examples; a discussion of why this technique is so valuable.

24-min. B&W Film or Videotape
28-0205 Purchase $165 Rental $20.

Power Series Solutions
A review of previous techniques; a key existence theorem; using power series to find an existing solution; some examples.

33-min. B&W Film or Videotape
28-0206 Purchase $220 Rental $22.

Laplace Transforms
Functions of exponential order; the definition of the Laplace transform of a function; computing the Laplace transform of some special functions; some notes on Laplace transforms; the linear aspects of Laplace transforms; a key property about Laplace transforms; applications to linear differential equations; Lerch's Theorem.

38-min. B&W Film or Videotape
28-0207 Purchase $250 Rental $25.

Linear Algebra

Eight B&W 16mm Films or Videotapes

Vector Spaces
An axiomatic definition of structure; some important theorems; discussion of how the axiomatic definition generalizes the n-tuple definition; a geometric interpretation; the concept of a subspace.

31-min. B&W Film or Videotape
28-0301 Purchase $210 Rental $21.

LINEAR ALGEBRA - Complete Set

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Complete set of *eight* B&W 16 mm films or videotapes

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Suggested Text

Calculus and Analytic Geometry (Fourth Edition) by G.B. Thomas, Addison-Wesley, 1968, 818 pp.

26-3000 Purchase $16.95 each.

Supplementary Notes

A supplement to the text, providing background information on number systems and expanding on the concepts of linear independence and differential operators. 92 pp.

28-4000 Purchase $4.00 each.

Study Guide

Pretest, chalkboard, photographs reading assignments, problems, solutions, quiz. 398 pp. (One per student recommended.)

28-2300 Purchase $13.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Suggested Text, and Supplementary Notes.

Spanning Vectors
Definition of spanning vectors; some examples; the definition of linear dependence and linear independence; some examples; a new look at the dimension of a vector space; constructive examples.

27-min. B&W Film or Videotape
28-0302 Purchase $180 Rental $20.

Constructing Bases
Review of previous lecture; definition of a basis for a vector space; some important observations; constructing a basis for a given vector space; the invariance of the dimension of a vector space in terms of basis vectors; using matrices to show when one vector is a linear combination of other vectors.

36-min. B&W Film or Videotape
28-0303 Purchase $235 Rental $24.

Linear Transformations
Definition of a linear transformation; properties of linear transformations; some examples; the relationship between linear transformations and matrices; more examples; the matrix of a linear transformation relative to a particular basis.

36-min. B&W Film or Videotape
28-0304 Purchase $235 Rental $24.

Determinants
Inventing a technique for telling us when n vectors can be the basis of an n-dimensional vector space. The properties which define a determinant; some consequences of these properties; some examples and "short-cuts".

39-min. B&W Film or Videotape
28-0305 Purchase $255 Rental $26.

Eigenvectors
Solving the vector equation $f(v) = cv$; geometric interpretation; some applications; a matrix approach to eigenvectors from the choice of a basis; some important invariants; some examples.

31-min. B&W Film or Videotape
28-0306 Purchase $210 Rental $21.

Dot Products
Generalized properties of the dot product; examples; the Gram-Schmidt orthogonalization process; constructing an orthonormal basis for a given vector space.

41-min. B&W Film or Videotape
28-0307 Purchase $265 Rental $27.

Orthogonal Functions
Orthogonal functions; definition of Fourier series; some special cases; constructing the Fourier series for some given functions and a pictorial interpretation; a discussion of errors.

34-min. B&W Film or Videotape
28-0308 Purchase $225 Rental $23.

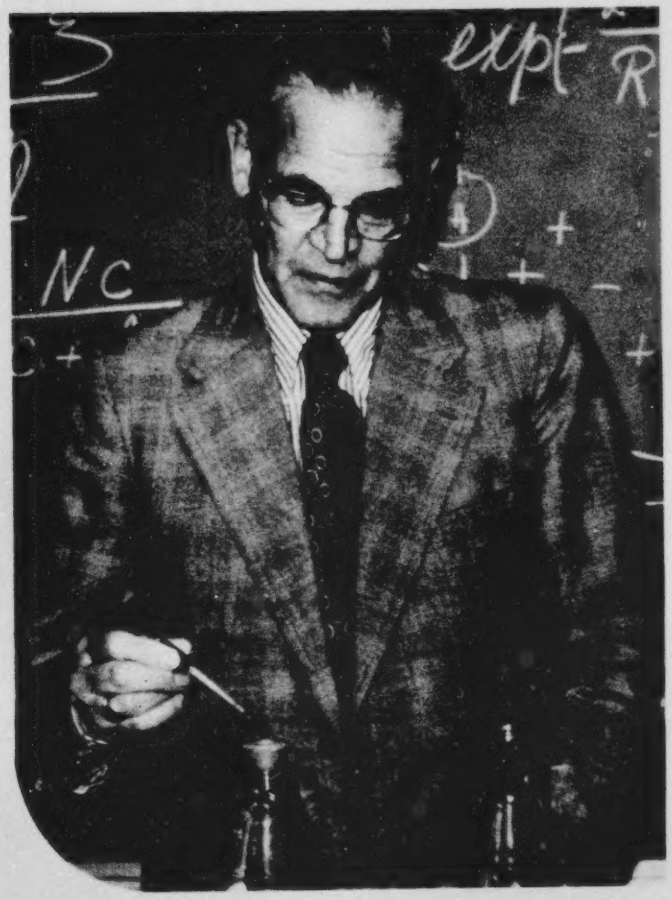
Colloid and Surface Chemistry

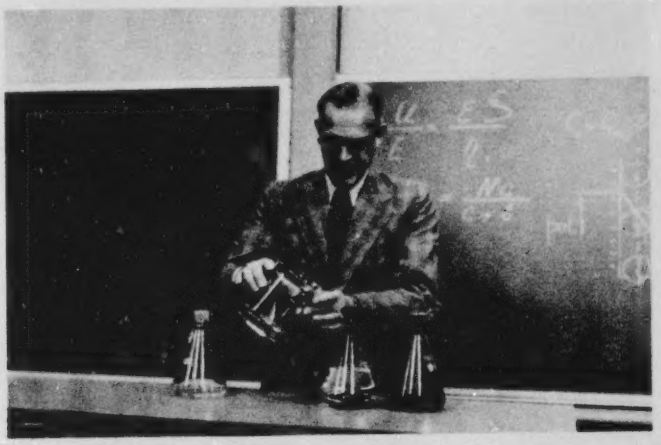
J. Th. G. Overbeek

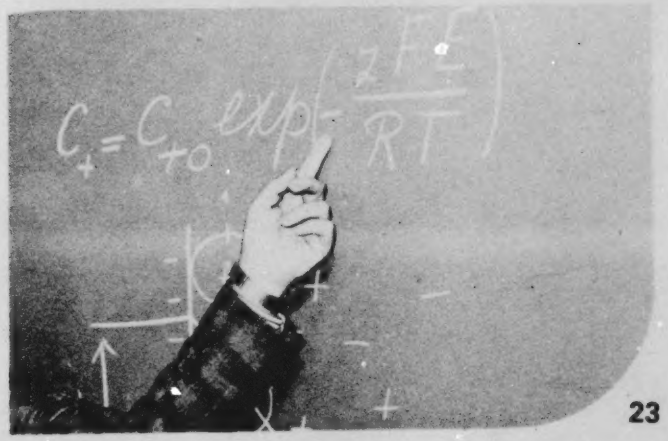
Colloid and Surface Chemistry is a set of 55 lectures and demonstrations on surface chemistry, lyophobic colloids, electrokinetics and membrane phenomena, and lyophilic colloids.

Interfacial phenomena play a significant role in a large number of processes in the chemical, petroleum, and metallurgical industries as well as in the biological processes of life iteself. Lyophobic colloids -- paints, dyes, coatings, cosmetics, pharmaceuticals, food products -- also play an important role in our daily lives. An understanding of electrokinetic phenomena has contributed to a number of analytical techniques and industrial processes. And lyophilic colloids not only include the extremely important polymers and reversible associates, but constitute the very basis for life in the form of proteins and nucleic acids.

J. Th. G. Overbeek is Professor of Physical Chemistry at the University of Utrecht in the Netherlands.







Colloid and Surface Chemistry

Surface Chemistry

Sixteen B&W 16mm Films or Videotapes

Introduction to Colloid Chemistry and its Relation to Surface Chemistry and Electrochemistry
Disperse systems are of interest both for their many applications and as systems worthy of fundamental study. Their large interfacial area explains why surface chemistry and surface electrochemistry are intrinsic facets of colloid chemistry.

36-min. B&W Film or Videotape
11-0101 Purchase $235 Rental $24.

Surface Tension and Surface Energies
Surface tension results from an inbalance of intermolecular forces. Relations between surface tension and (Helmholtz and Gibbs) surface free energies. Hydrostatic pressure (Young, Laplace) and modified vapor pressure (Kelvin) at curved interfaces.

40-min. B&W Film or Videotape
11-0102 Purchase $260 Rental $26.

Measurement of Surface and Interfacial Tensions of Liquids (1)
Static and dynamic measurements related to curvature of a meniscus: capillary rise or depression, maximum bubble pressure, stalagmometer (drop weight).

25-min. B&W Film or Videotape
11-0103 Purchase $175 Rental $18.

Measurement of Surface and Interfacial Tensions of Liquids (2)
Sessile or pendant drop or bubble, Wilhelmi plate, du Nouy ring, surface ripples, oscillating jet.

37-min. B&W Film or Videotape
11-0104 Purchase $260 Rental $26.

Adsorption, Analytical Aspect
Surface or interface is a region of finite thickness. Description of (positive or negative) surface excess with Gibbs dividing surface. Guggenheim method with two dividing surfaces. Invariant linear combinations of surface excesses.

25-min. B&W Film or Videotape
11-0105 Purchase $170 Rental $20.

Thermodynamics of Fluid Interfaces
The Gibbs adsorption equation and the concept of the surface excess concentration. Importance of -log c or -log a plots. Saturation adsorption. Critical micelle concentration.

48-min. B&W Film or Videotape
11-0106 Purchase $305 Rental $31

Spreading - Surface Films of Insoluble Monolayers
Spreading tension, initial and final. Neumann's triangle. Influence of surfactants on spreading. Surface pressure. Langmuir trough, film balance. Surface equation of state, surface potential, surface viscosity and elasticity. Effect of monolayers on evaporation. Multilayers.

51-min. B&W Film or Videotape
11-0107 Purchase $360 Rental $36.

Surface Tension and Surface Structure of Solids
Experiments on surface tension. Calculation of surface (free) energies. Methods of determining surface structure and modern spectroscopy and electronic analytical methods. How to obtain large specific surface area.

52-min. B&W Film or Videotape
11-0108 Purchase $325 Rental $33.

Adsorption of Gases on Solids
Physisorption, chemisorption. Adsorption isotherms, Langmuir, BET, Harkins and Jura, Polanyi, Frenkel, Halsey, Hill, de Boer (t-plot). Heterogeneity. Steps in isotherms. Capillary condensation, hysteresis, pore size distribution.

54-min. B&W Film or Videotape
11-0109 Purchase $330 Rental $33.

Chemisorption - Adsorption from Solution
Chemisorption, monolayer, large heat of adsorption, Freundlich (Kuster) isotherm. Adsorption from solution is always competitive. Determination of adsorption. Traube's rule (standard free energy of adsorption per CH_2-group.

30-min. B&W Film or Videotape
11-0110 Purchase $210 Rental $21.

Adsorption from Solution, Continued. Contact Angles
Adsorption of polymers, of ions. Negative adsorption. Chromatography. Contact angle. Influence of surfactants. Wetting, dewetting, froth-flotation. Contact angle hysteresis.

42-min. B&W Film or Videotape
11-0111 Purchase $295 Rental $30.

Energies and Entropy of Adsorption
Relations between Γ, π (or γ) and c (or p). Calorimetric and isosteric heats of adsorption. Enthalpies and entropies in models, such as Langmuir, B.E.T., mobile monolayer. Conversion of adsorption isotherm into equation of state and vice versa.

41-min. B&W Film or Videotape
11-0112 Purchase $265 Rental $27.

Charged Interfaces - Electrochemistry of the Phase Boundary
Lippmann equation. Electroneutrality of interfaces. Completely reversible and completely polarizable electrodes. Potential determining ions.

39-min. B&W Film or Videotape
11-0113 Purchase $255 Rental $26.

Surface Potentials - Structure of the Electric Double Layer
Outer and inner electric potential difference. "Real potential." Double layer. Poisson-Boltzmann equation. Gouy, Chapman, Stern models. Thickness and capacity of double layer.

54-min. B&W Film or Videotape
11-0114 Purchase $380 Rental $38.

SURFACE CHEMISTRY - Complete Set

Films/Videotapes

Complete set of *sixteen* B&W 16 mm films or videotapes.

11-1100 Purchase $3900 (SAVE $580)
80 Day Rental $410 (SAVE $45)

Suggested Text

Physical Chemistry of Surfaces by A.W. Adamson, Interscience, (Second Edition), 1967, 747 pp.

11-3100 Purchase $21.75 each.

Study Guide

Lecture summaries and discussions, photographs, reading assignments, problems, and problem solutions. 278 pp. (One per student recommended.)

11-2100 Purchase $12.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

A Few Special Aspects of Double Layers
Negative adsorption of co-ions. Ion-exchange. Point of zero charge. Double layers in ionic crystals and semiconductors. Rate of charge adjustment.

42-min. B&W Film or Videotape
11-0115 Purchase $270 Rental $27.

Free Energy of Double Layers - Electrocapillarity
Calculation of surface free energy: Chemical and electrical parts. Electrocapillary curve. Charge and capacitance for Hg/aqueous solutions. Other double layers: inorganics, oil, and gas, all against water.

55-min. B&W Film or Videotape
11-0116 Purchase $385 Rental $39.

Lyophobic Colloids

Fifteen B&W 16mm Films or Videotapes

Introduction on Stability of Lyophobic Colloids
Size Range (1nm - 1µm) of colloidal particles...distinction between lyophobic and lyophilic colloids...emphasis on stability and coagulation (= flocculation) of lyophobic colloids and other geometries.

29-min. B&W Film or Videotape
11-0201 Purchase $195 Rental $20.

Interaction Between Two Double Layers
Two parallel flat double layers... Poisson-Boltzmann equation... constant charge or constant surface potential...change in Gibbs free energy...Langmuir's force method...Stern correction.

47-min. B&W Film or Videotape
11-0202 Purchase $330 Rental $33.

Interaction Between Spherical Double Layers - Schiller Layers and Other Experiments on Double Layer Interaction
Derjaguin's method for spheres... small separations...large separations...Schiller layers, Tobacco mosaic virus, lipid layers.

36-min. B&W Film or Videotape
11-0203 Purchase $250 Rental $25.

Van der Waals Forces
Van der Waals forces responsible for long range attraction... additivity...flat plates, spheres.

29-min. B&W Film or Videotape
11-0204 Purchase $195 Rental $20.

Van der Waals Forces - Influence of a Medium - Retardation - Lifshitz Method - Experiments
Van der Waals forces between particles in a medium always attractive...retardation at large distances...Lifshitz' approach...experiments.

39-min. B&W Film or Videotape
11-0205 Purchase $255 Rental $26.

Combinations of Attraction and Repulsion - Application to Colloid Stability
Potential energy curves...rule of Schulze and Hardy...flocculation series...DLVO theory...ions with abnormal flocculating power... irregular series...charge reversal.

38-min. B&W Film or Videotape
11-0206 Purchase $270 Rental $27.

Colloid Stability - Lyotropic Effects - Repeptization
Influence of lyotropic series on flocculation...requirements for reversibility (repeptization)... secondary minimum...mutual flocculation.

40-min. B&W Film or Videotape
11-0207 Purchase $280 Rental $28.

Foams and Soap Films (1)
Coarsening of foams by diffusion, drainage, and breaking...color and thickness of soap films... black soap films...self-healing Gibbs-Marangoni effect... drainage mechanisms...Van der Waals and repulsive forces.

39-min. B&W Film or Videotape
11-0208 Purchase $275 Rental $28.

Foams and Soap Films (2)
Second black films...foam breakers...light scattering and breaking due to surface fluctuations...sharp transition of colored (silver) to black films...applications of foams.

38-min. B&W Film or Videotape
11-0209 Purchase $270 Rental $27.

Emulsions - Suspensions in Non-Aqueous Media
Emulsions stabilized by surfactants or by finely divided solids... creaming, coalescence, breaking... O/W and W/O emulsions...inversion ...applications of emulsions... non-aqueous suspensions: stability, as affected by electrolytes, permitivity, and particle concentration...applications.

39-min. B&W Film or Videotape
11-0210 Purchase $275 Rental $28.

Steric Stabilization - Sensitized Flocculation
Stabilization by adsorbed polymers ...anchor and tail (or loop)... repulsion by osmotic effect and by restriction of possible conformations...examples...sensitized flocculation due to bridging... applications.

41-min. B&W Film or Videotape
11-0211 Purchase $290 Rental $29.

Coarse Suspensions - Rheology
Sediment density and flow behavior as funciton of suspension stability...thixotropy...gel formation by flocculation or addition of third phase... applications.

57-min. B&W Film or Videotape
11-0212 Purchase $395 Rental $39.

Sol Preparation, Dialysis and Ultrafiltration
Dispersion and condensation methods...preparing isodisperse sols...dialysis, electrodialysis, ultrafiltration...demonstration of preparation of several sols... spontaneous emulsification.

57-min. B&W Film or Videotape
11-0213 Purchase $395 Rental $39.

LYOPHOBIC COLLOIDS - Complete Set

Films/Videotapes

Complete set of *fifteen* B&W 16 mm films or videotapes.

11-1200 Purchase $3840 (SAVE $575)
75 Day Rental $399 (SAVE $44)

Suggested Texts

Physical Chemistry of Surfaces by A.W. Adamson, Interscience, (Second Edition), 1967, 747 pp.

11-3100 Purchase $21.75 each.

Colloid Science Volume 1 edited by H.R. Kruyt, Elsevier Publishing Company, 1974, 389 pp.

11-3200 Purchase $24.00 each.

Study Guide

Lecture summaries and discussions, photographs, reading assignments, problems, and problem solutions. 302 pp. (One per student recommended.)

11-2200 Purchase $13.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Particle Size Determination - Optics
Microscope...sedimentation... Coulter counter...electron-microscope...ultramicroscope... Tyndall light...Rayleigh and Mie theories...higher order Tyndall spectra...birefringence... tactoids.

56-min. B&W Film or Videotape
11-0214 Purchase $395 Rental $39.

Kinetics of Flocculation
Rapid and slow flocculation... Von Smoluchowski's theory... extension by Fuchs to slow flocculation...log W - log c curves ...experiments...influence of stirring.

57-min. B&W Film or Videotape
11-0215 Purchase $345 Rental $35.

Electrokinetics and Membrane Phenomena

Nine B&W 16mm Films or Videotapes

Introduction. The Four Electrokinetic Effects. The Zeta-Potential
Relationships between liquid motion and electric field near an interface...Electroosmosis, electrophoresis, electrodeposition, streaming potential, streaming current, migration potential.

54-min. B&W Film or Videotape
11-0301 Purchase $380 Rental $38.

Theory of Electrophoresis
Influence of κa (κ = reciprocal thickness of double layer, a = radius of particle) on electrophoretic mobility. Relaxation effects.

29-min. B&W Film or Videotape
11-0302 Purchase $195 Rental $20.

Applications of Electrokinetics
Influence of counterion charge and concentration on zeta-potential ...Concept of "slipping plane"... Techniques for determining electrophoretic mobility and for preparative electrophoresis... Applications, including fire hazards of high streaming potentials, separation of protein mixture, concentrating sols by electrodecantation, electrodeposition of latex and pigments from suspensions.

53-min. B&W Film or Videotape
11-0303 Purchase $370 Rental $37.

Non-Equilibrium Thermodynamics Applied to Electroosmosis and Streaming Potential
Entropy production in irreversible phenomena...Fluctuations... Onsager's reciprocal relations ...Saxen's relation between electroosmosis and streaming potential.

38-min. B&W Film or Videotape
11-0304 Purchase $250 Rental $25.

Schmid Membrane Model. Non-Equilibrium Thermodynamics of Electrophoresis and Sedimentation Potential
In Schmid model for membrane ζ is replaced by density of fixed charges...Electrophoresis and sedimentation potential connected by Onsager relation... Concentration dependence of rate of sedimentation.

30-min. B&W Film or Videotape
11-0305 Purchase $205 Rental $21.

Introduction to Membrane Potentials
Treatment based on galvanic cell reaction...Reversible electrodes or salt bridges.

26-min. B&W Film or Videotape
11-0306 Purchase $175 Rental $20

Membrane Potentials. Incomplete Selectivity; Bi-Ionic Potentials; Filtration through Membrane
Selectivity based on fixed charge of the membrane...Meyer-Sievers - Theorell theory of incomplete selectivity...Bi-ionic potentials...Desalination by electrodialysis...Flow of ions, solvent, electric current through membrane.

40-min. B&W Film or Videotape
11-0307 Purchase $260 Rental $26.

The Donnan Equilibrium
Donnan treatment of distribution of ions, osmotic pressure and membrane potential ...Non-ideality based on inhomogeneity of Donnan phase.

39-min. B&W Film or Videotape
11-0308 Purchase $255 Rental $25.

The Donnan Potential. The Suspension Effect
Donnan potential treated as a series of three diffusion potentials...Importance of contributions of liquid junctions with saturated KCl..The suspension (Wiegner-Pallmann) effect.

30-min. B&W Film or Videotape
11-0309 Purchase $205 Rental $21.

Lyophilic Colloids

Fifteen B&W 16mm Films or Videotapes

Introduction. Solutions of Lyophilic Colloids. Examples of Macromolecules
Solutions of polymers...Survey of biocolloids, synthetic polymers and polycondensates, their role in nature and fields of application.

55-min. B&W Film or Videotape
11-0401 Purchase $385 Rental $39.

Polymer Synthesis. The Importance of Polymers. Their Specific Role
Free radical polymerization. Kinetic aspects. Pearl-and emulsion-polymerization. Ionic polymerization. Stereo-regular polymers. Polycondensation. Intra - and intermolecular forces, rubber elasticity, information storage in biopolymers.

55-min. B&W Film or Videotape
11-0402 Purchase $385 Rental $39.

Statistics of Polymer Coil Conformations. Viscosity of Polymer Solutions
Random flight statistics. Distribution function of end-to-end distance. "Statistical chain element." Viscosity of solutions of coils.

40-min. B&W Film or Videotape
11-0403 Purchase $260 Rental $26.

ELECTROKINETICS - Complete Set

Films/Videotapes

Complete set of *nine* B&W 16 mm films or videotapes.

11-1300 Purchase $2065 (SAVE $230)
45 Day Rental $217 (SAVE $16)

Suggested Text

Colloid Science Volume 1 Edited by H.R. Kruyt, Elsevier Publishing Company, 1974, 389 pp.

11-3200 Purchase $24.00.

Study Guide

Lecture summaries and discussions, photographs, reading assignments, problems, and problem solutions. 156 pp. (One per student recommended.)

11-2300 Purchase $6.50 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Rubber Elasticity.
Force vs. elongation relation for ideal rubber derived from entropy change on deformation. Glass transition temperature. Brittle point.

39-min. B&W Film or Videotape
11-0404 Purchase $255 Rental $26.

Thermodynamics of Polymer Solutions. Osmotic Pressure
Flory-Huggins theory. Quasi-lattice model. Energy, entropy and free energy of mixing "Very dilute" solutions. Theta-temperature. Fractionation.

52-min. B&W Film or Videotape
11-0405 Purchase $325 Rental $33.

Molecular Weight Distributions. Determination of Average Molecular Weight by Osmotic Pressure, Chemical Analysis, Viscosity
Integral (or cumulative) and differential molecular weight distributions. Different kinds of average molecular weights. Number average M. Viscosity average M.

42-min. B&W Film or Videotape
11-0406 Purchase $270 Rental $27.

Light Scattering
Light Scattering in Rayleigh approximation (size $<\lambda/20$) gives mass-average M. Fluctuation theory of light scattering. Non-ideality of solutions. Zimm-plot.

39-min. B&W Film or Videotape
11-0407 Purchase $255 Rental $26.

The Ultracentrifuge
Rate of sedimentation and diffusion. The Svedberg equation. Shape factor. Sedimentation equilibrium. Archibald method. Applications.

51-min. B&W Film or Videotape
11-0408 Purchase $320 Rental $32.

Polyelectrolytes. Examples, Titration Curves, Electrophoresis
Examples of natural and synthetic polyelectrolytes. Titration curve gives information on electrical free energy of coil. Titration of proteins. Iso-electric point.

38-min. B&W Film or Videotape
11-0409 Purchase $250 Rental $25.

LYOPHILIC COLLOIDS - Complete Set

Films/Videotapes

Complete set of *fifteen* B&W 16 mm films or videotapes.

11-1400 Purchase $4125 (SAVE $615)
75 Day Rental $430 (SAVE $48)

Suggested Text

Principles of Polymer Chemistry by Paul J. Flory, Cornell University Press, 1971, 672 pp.

11-3400 Purchase $24.50 each.

Study Guide

Lecture summaries and discussions, photographs, reading assignments, problems, and problem solutions. 306 pp. (One per student recommended.)

11-2400 Purchase $13.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Polyelectrolytes. Viscosity, Light Scattering, Osmotic Pressure, Sedimentation
Three causes for the electroviscous effect are expansion of coils, deformation of double layer and mutual repulsion of polyions. Light scattering depends strongly on θ and c.

49-min. B&W Film or Videotape
11-0410 Purchase $310 Rental $31.

Coacervation, Salting Out
Precipitation of polyelectrolytes by organic non-solvents and electrolytes..."Salting out" ...Lyotropic series...Properties of coacervates. Complexcoacervates between polycations and polyanions...Double Schulze-Hardy rule. Incompatibility of non-charged polymers. Nucleoproteins and globulins.

49-min. B&W Film or Videotape
11-0411 Purchase $345 Rental $35.

Complexcoacervates. Electrophoresis. Structure of Proteins and Nucleic Acids
Buchner-effect and decomposition in electrophoresis. Autocomplexcoacervation. Theory of complexcoacervation based on Flory-Huggins theory with addition of electrostatic interaction. Microencapsulation. Helical structures in proteins and nucleic acids. Denaturation.

59-min. B&W Film or Videotape
11-0412 Purchase $395 Rental $39.

Association Colloids. Micelle Formation. Phase Diagrams
Critical micelle concentration. Size and shape of micelles. Law of mass-action explains sharp c.m.c. Driving force for micelle formation mostly entropy based. Influence of salt concentration of c.m.c. and micelle size.

55-min. B&W Film or Videotape
11-0413 Purchase $335 Rental $34.

Association Colloids. Micellar Size. Thermodynamics. Applications
Micelle molecular weight best by light scattering. Correction for negative adsorption of co-ions. Thermodynamics of micelle formation. Hartley, Debye, Stigter. Cell membrane.

50-min. B&W Film or Videotape
11-0414 Purchase $315 Rental $32.

Gels
Structural requirements for gelation. Sharp gel point. Crystalline regions as crosslinks. Syneresis. Soap gels, jelly and curd. Swelling. "Memory" of gels. Theory of swelling. Polyelectrolyte gels. Mechanochemistry.

48-min. B&W Film or Videotape
11-0415 Purchase $335 Rental $34.

A Visit with J. Th. G. Overbeek
The serious lecturer of the Colloid and Surface Chemistry series gives way to the warm human being behind the theories and demonstrations. In an interview with John T. Fitch of the MIT Center for Advanced Engineering Study, Theo Overbeek recounts his life story (beginning with his "firm decision" not to be a teacher!) including the development of the D.L.V.O. theory.

30-min. Color Videotape
11-0501 Purchase $210 Rental $21.

Computer Languages

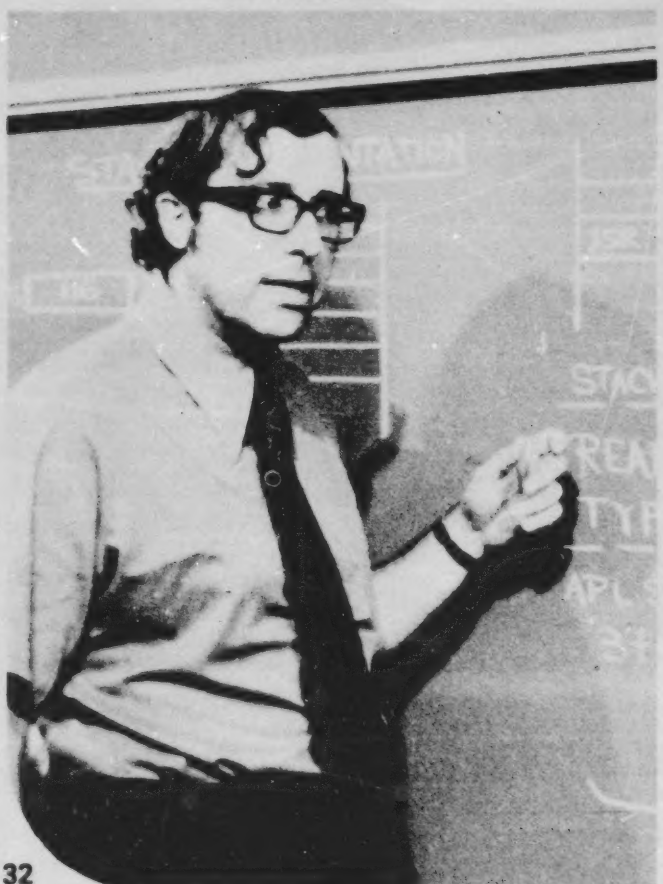
Michael L. Dertouzos

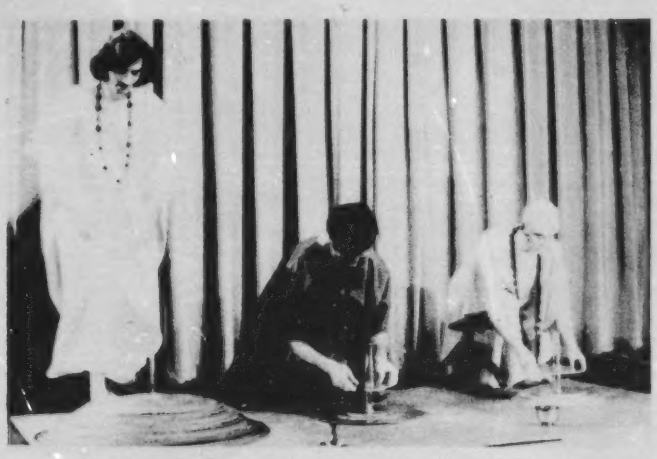
Computer Languages: Structure and Interpretation focuses on issues which must be addressed in the design or implementation of any programming system -- independent of its individual details. These issues include:

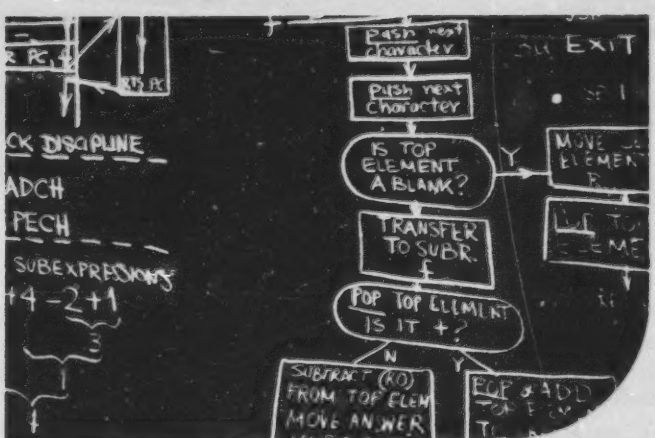
- the means by which a variable is associated with its value.
- the time at which the value of a variable is calculated.
- the logical power of a language
- the efficiency and expressibility of a language.
- the use of functions to process other functions.
- the translation of a language into the constructs of another language.

The videotapes in this series comprise un-edited lectures and classroom discussions as well as four specially prepared studio productions.

Michael L. Dertouzos is Professor of Electrical Engineering and Computer Science at MIT and Director of the MIT Laboratory for Computer Science (formerly Project MAC).







Computer Languages

Thirty-nine
Color Videotapes

Introduction to Computer Science
This lecture is a succinct answer to two basic questions:
(1) What is computer Science?
(2) How does it differ, in its nature, from the other sciences and engineering disciplines?
In answering these questions, the lecture states the premises and goals of the course, and outlines the material that will be covered.

≈50-min. Color Videotape
14-0101 Purchase $300 Rental $30.

Introduction to Machine Language
Early processor and memory access models. Need for relative addressing, indirection, stacks, subroutines. Overview of M machine (PDP-11) instruction set. Byte/word addressing. Execution cycle.

≈50-min. Color Videotape
14-0102 Purchase $300 Rental $30.

M Machine Language
Addressing modes, instruction formats. Types of instructions; opcodes. Examples. Octal vs. binary notation.

≈50-min. Color Videotape
14-0103 Purchase $300 Rental $30.

The Need for Subroutines & Stacks
Backus-Naur Form (BNF) as a recursive structure definition. Use of a stack for implementing recursive programs. Examples.

≈50-min. Color Videotape
14-0104 Purchase $300 Rental $30.

Subroutines and Stack Discipline
Stack operations. Stack discipline and its importance. Mathematical induction. Subroutines; types of call-return sequences. Methods of passing parameters. The JSR and RTS instructions.

≈50-min. Color Videotape
14-0105 Purchase $300 Rental $30.

Assembly Language
Goals of assembly language. Structure of A(M): lables, mnemonics, address calculation; Pseudo operations; symbolic expressions. ASCII codes; the name-value distinction.

≈50-min. Color Videotape
14-0106 Purchase $300 Rental $30.

Structure of Assemblers
The translation process. How A(M) works; use of symbol tables. 1 vs. 2 passes. Space-time tradeoffs.

≈50-min. Color Videotape
14-0107 Purchase $300 Rental $30.

Applicative Expressions (AEs)
Applicative vs. imperative features of languages. Informal syntax of AEs. Universe of discourse. Informal semantics.

≈50-min. Color Videotape
14-0108 Purchase $300 Rental $30.

Meaning of AEs
Functionality. Development of the normal value algorithm from intuitive notions of meaning. The substitution rule.

≈50-min. Color Videotape
14-0109 Purchase $300 Rental $30.

Use of the Normal Value Algorithm.
Evaluations using the nv algorithm. Free and bound variables. Conditionals, logic values.

≈50-min. Color Videotape
14-0110 Purchase $300 Rental $30.

Conditionals
Review of free & bound variables. Different ways of implementing conditional operations. Importance of not evaluating both branches. Augmentation of the nv algorithm.

≈50-min. Color Videotape
14-0111 Purchase $300 Rental $30.

Ramifications of Normal Value
Relativity of priviledged names. Implications of changes in order of evaluation. Church-Rosser theorem explained intuitively. Control trees.

≈50-min. Color Videotape
14-0112 Purchase $300 Rental $30.

Introduction to Environments
Motivation for binding variables to values in an environment. The global environment; bind, lookup functions. Definition of the global environment evaluator (G-machine).

≈50-min. Color Videotape
14-0113 Purchase $300 Rental $30.

Problems of the G-Machine
Review of G-machine algorithm. Control trees, recursion in the G-machine. Demonstration of identifier collision.

≈50-min. Color Videotape
14-0114 Purchase $300 Rental $30.

The Stack Environment (S-Machine)
Identifier collision as motivation for a stack structured environment. Definition of the S-machine. Control trees.

≈50-min. Color Videotape
14-0115 Purchase $300 Rental $30.

Recursion in G & S
Examples demonstrating the implementation of recursive programs in global and stack environments. (Quiz review.)

≈50-min. Color Videotape
14-0116 Purchase $300 Rental $30.

Abstract Recursion
The advantages of recursion over iteration. Recursive programs in normal order. The fixed point property; the Y operator. Examples.

≈50-min. Color Videotape
14-0117 Purchase $300 Rental $30.

Logical Power of Computing Schemes
The theoretical notions of computability and universality are the central issues of this lecture. Topics covered include:
Turing machines
coding schemes
proof that uncomputable functions exist
Russell's paradox
universality - the Church-Turing thesis
tests for universality

≈50-min. Color Videotape
14-0118 Purchase $300 Rental $30.

Recursive Function Theory
This lecture continues the subject of computability that was begun in Lecture 14-0118 by defining the computing scheme known as the recursive functions. Examples of recursive functions are constructed, and the importance of the scheme is discussed. (Recursive function theory should not be confused with recursive programming.)

≈50-min. Color Videotape
14-0119 Purchase $300 Rental $30.

Introduction to LISP
Pure LISP in relation to AEs. Arithmetic functions and predicates. COND syntax. The LABEL primitive.

≈50-min. Color Videotape
14-0120 Purchase $300 Rental $30.

S-Expressions
S-expressions and the functions which operate on them. CAR, CDR, CONS. List notation.

≈50-min. Color Videotape
14-0121 Purchase $300 Rental $30.

Lists
Lists and atoms. The pseudo-function QUOTE and its significance. Programming techniques for list processing functions.

≈50-min. Color Videotape
14-0122 Purchase $300 Rental $30.

Evaluators (1)
Development of the S-machine (stack evaluator for AEs) written in LISP.

≈50-min. Color Videotape
14-0123 Purchase $300 Rental $30.

Evaluators (2)
Conclusion of S-machine in LISP. Minimal pure LISP evaluator written in LISP.

≈50-min. Color Videotape
14-0124 Purchase $300 Rental $30.

Evaluators (3)
The classic EVAL-APPLY structured LISP evaluator, in LISP. Extensibility of the model. Why QUOTE is not a function.

≈50-min. Color Videotape
14-0125 Purchase $300 Rental $30.

Evaluators (4)
Comparison of MPLEVAL, EVAL-APPLY, and normal order schemes. Levels of evaluation. Implementation of lists. Box-pointer notation; sharing.

≈50-min. Color Videotape
14-0126 Purchase $300 Rental $30.

FUNARG Problems (SAW)
Peculiarities of DELPHI LISP. Upward and downward FUNARG functional argument) problems as a consequence of a stack-structured environment. Motivation of tree-structured environment.

≈50-min. Color Videotape
14-0127 Purchase $300 Rental $30.

Possible Cures for FUNARG Problems
Informal usage of function closures (T-machine). Control trees in the T-machine.

≈50-min. Color Videotape
14-0128 Purchase $300 Rental $30.

Tree Environment (1)
Definition of T-machine in LISP, as a modification of the S-machine. Examples of usage.

≈50-min. Color Videotape
14-0129 Purchase $300 Rental $30.

Tree Environment (2)
Upward funarg problem, as evaluated by the T-machine. Sketch of equivalence proof for tree machine and normal order algorithm.

≈50-min. Color Videotape
14-0130 Purchase $300 Rental $30.

Imperative LISP (1)
Syntax and semantics of SET, SETQ; DEFUN; motivation for and usage of RPLACA, RPLACD.

≈50-min. Color Videotape
14-0131 Purchase $300 Rental $30.

Imperative LISP (2)
Review RPLACA, RPLACD. Construction of circular lists. Implementation of SET and SETQ. Call by name; call by value. Call by reference.

≈50-min. Color Videotape
14-0132 Purchase $300 Rental $30.

Sequencing
The primitives PROG2, PROGN. The PROG construct; RETURN, GO, labels. Motivate global labels (label closures).

≈50-min. Color Videotape
14-0133 Purchase $300 Rental $30.

Dynamic Allocation of Storage
The free storage list. Garbage collection - marking and sweeping. Reference counters. The Deutsch algorithm.

≈50-min. Color Videotape
14-0134 Purchase $300 Rental $30.

Global Labels (1)
The control state. Problems caused by non-local GOs. Development of label closures as solution.

≈50-min. Color Videotape
14-0135 Purchase $300 Rental $30.

Global Labels (2)
Application of global labels in error handling, backtracking. Multiprocessing using label closures.

≈50-min. Color Videotape
14-0136 Purchase $300 Rental $30.

Principles of Translation
Relation of translation to interpretation. Efficiency advantages of translation. Translation of AE's to LISP.

≈50-min. Color Videotape
14-0137 Purchase $300 Rental $30.

AE's to Assembly Language (1)
Overall plan - applicative to imperative schemes. Translation time environments. Shallow binding. Need for run-time interpretation.

≈50-min. Color Videotape
14-0138 Purchase $300 Rental $30.

AE's to Assembly Language (2)
Continuation of previous recitation with an example worked out.

≈50-min. Color Videotape
14-0139 Purchase $300 Rental $30.

COMPUTER LANGUAGES - Complete Set

Color Videotapes

Complete set of *thirty-nine* Color Videotapes

14-1100 Purchase $9945 (SAVE $1755)
195 Day Rental $995 (SAVE $175)

The following four videotapes are color studio productions. The first two cover some of the material in the classroom lectures and recitations listed above -- in compressed form. They can be used in place of the earlier tapes for students with more programming experience. The second two tapes augment the lectures and recitations and can usefully be shown in conjunction with them.

Machine Language
Covers the material of 14-0102 and 14-0103 in compressed form. Uses the PDP-11 as an example of an actual machine. Topics include organization of the machine and its major components, the various representations of data, the execution cycle of the machine, and the actions performed by a sampling of the machine's instruction repertoire.

55-min. Color Videotape
14-0201 Purchase $385 Rental $39.

Assembly Language, Subroutines, and Stacks
Covers the material of 14-0104, 14-0105, and 14-0106 in compressed form. Includes symbolic labels and expressions, mnemonics, pseudooperations, subroutines. Motivates stacks as a means for storing subroutine return points. Develops notion of stack discipline.

55-min. Color Videotape
14-0202 Purchase $385 Rental $39.

Recursion
Visiting Professor Joseph Stoy explains and demonstrates the process of writing recursive programs, i.e. programs that invoke themselves. Detailed examples are illustrated (viz. three "monks" working on the Towers of Hanoi puzzle) and worked out to clarify this frequently misunderstood topic.

40-min. Color Videotape
14-0203 Purchase $330 Rental $33.

DELPHI
A demonstration of the DELPHI timesharing system at a level designed for the student with a minimum of previous computer experience. Instruction includes: logging in and out, using the editor and assembler, and using the LISP interpreter.

49-min. Color Videotape
14-0204 Purchase $370 Rental $37.

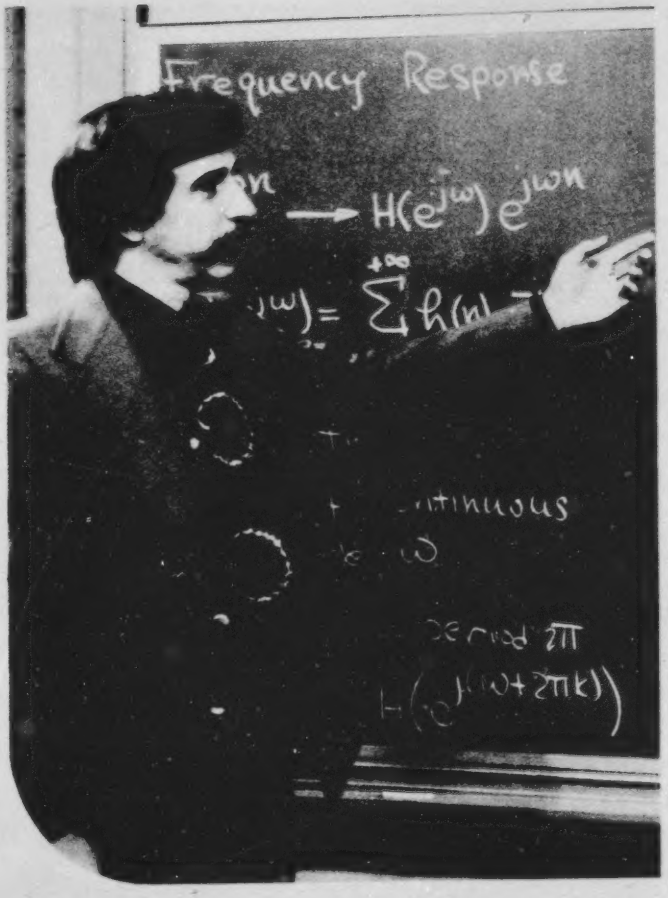
Digital Signal Processing

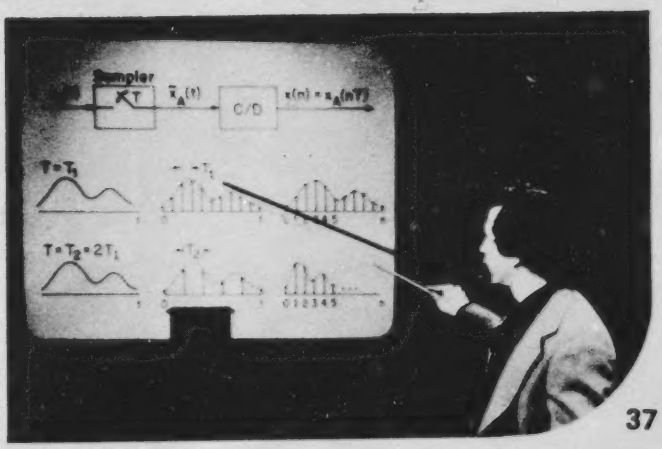
Alan V. Oppenheim

Digital Signal Processing is now being applied to such diverse areas as biomedical engineering, acoustics, sonar, radar, seismology, speech communication, telephony, nuclear science, and image processing. This widespread application has been due, in large part, to the advances in integrated circuit technology which have had a profound impact on the techniques for transmitting and processing electrical signals.

This series of lectures and demonstrations begins with the definition of discrete time signals and systems. Topics covered include difference equations, discrete time Fourier transforms, the z-transform, digital filter design and implementation, and the fast Fourier transform.

Alan V. Oppenheim is Associate Professor of Electrical Engineering and Computer Science at MIT.





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Digital Signal Processing

Twenty-one
Color Videotapes

Introduction
Provides an overview of the course and discusses some of the applications of digital signal processing.

17-min. Color Videotape
22-0101 Purchase $170 Rental $20.

Discrete-Time Signals and Systems (1)
Definition of basic discrete-time signals: The unit sample, unit step, exponential and sinusoidal sequences. Definitions and representations of linear time-invariant discrete time systems. Properties of discrete-time convolution.

36-min. Color Videotape
22-0102 Purchase $310 Rental $31.

Discrete-time Signals and Systems (2)
Stability and causality for discrete-time systems. Systems describable by linear constant-coefficient difference equations. Frequency response of linear time-invariant systems.

50-min. Color Videotape
22-0103 Purchase $375 Rental $38.

The Discrete-Time Fourier Transform
Generalization of the frequency response representation of sequences. Inverse Fourier transform relation. Properties between continous-time and discrete-time Fourier transforms.

44-min. Color Videotape
22-0104 Purchase $350 Rental $35.

Sampling, Aliasing, and Frequency Response
Demonstration of sampling and aliasing with a sinusoidal signal. Sinusoidal response of a digital filter. Dependence of frequency response on sampling period. Periodic nature of the frequency response of a digital filter.

30-min. Color Videotape
22-0121 Purchase $275 Rental $28.

Demonstration of Sampling, Aliasing, and Frequency Response
Demonstrations (only) from above.

12-min. Color Videotape
22-0122 Purchase $120 Rental $20.

The Z-Transform
Relationship between the Fourier transform and the z-transform. Region of convergence for z-transforms. Relationship between region of convergence, causality and stability.

51-min. Color Videotape
22-0105 Purchase $375 Rental $38.

The Inverse Z-Transform
Techniques for determining the inverse z-transform: inspection method, use of power series expansion, partial fraction expansion, use of contour integration.

46-min. Color Videotape
22-0106 Purchase $360 Rental $36.

Z-Transform Properties
Geometric determination of frequency response from pole-zero patterns in the z-plane. Properties of z-transforms: scaling, differentiation, shifting, convolution, etc.

56-min. Color Videotape
22-0107 Purchase $390 Rental $39.

The Discrete-Fourier Series
Fourier series representation for periodic sequences. Determination of Fourier series coefficients. Properties of Fourier Series.

43-min. Color Videotape
22-0108 Purchase $345 Rental $35.

The Discrete-Fourier Transform
Fourier representation of finite length sequences. Relationship between the Discrete-Fourier series. Properties of the Discrete-Fourier transform: Symmetry, circular shifting, circular convolution, etc.

47-min. Color Videotape
22-0109 Purchase $360 Rental $36.

Circular Convolution
Circular convolution of finite length sequences. Interpretation of circular convolution as linear convolution followed by aliasing. Implementing linear convolution by means of circular convolution.

43-min. Color Videotape
22-0110 Purchase $345 Rental $35.

Representation of Linear Digital Networks
Block diagram representation of difference equations. Linear signal flow graphs. Flow graph representation of difference equations. Matrix representation of digital networks. Computability of digital networks.

52-min. Color Videotape
22-0111 Purchase $380 Rental $38.

Network Structures for Infinite Impulse Response (IIR) Digital Filters
Basic network structures for IIR filters: direct cascade and parallel form. Canonic structures. Transposition theorem for digital networks and the resulting transposed forms.

40-min. Color Videotape
22-0112 Purchase $330 Rental $33.

Network Structures for Finite Impulse Response (FIR) Digital Filters and Parameter-Quantization Effects in Digital Filter Structures
Direct form FIR filters. Efficient implementation of FIR filters with linear phase. Frequency sampling structure. Effects of parameter quantization in digital filter implementation.

51-min. Color Videotape
22-0113 Purchase $375 Rental $38.

Design of IIR Digital Filters (1)
Transformation of analog filter designs to digital filter designs; Approximation of derivatives by differences. Impulse invariant design procedures.

47-min. Color Videotape
22-0114 Purchase $360 Rental $36.

DIGITAL SIGNAL PROCESSING - Complete Set

Color Videotapes

Complete set of *twenty-one* Color Videotapes.

22-1100 Purchase $6180 (SAVE $1020)
105 Day Rental $646 (SAVE $82)

Suggested Text

Digital Signal Processing by A.V. Oppenheim and R. W. Schafer, Prentice Hall, 1975, 585 pp.

22-3100 Purchase $21.95 each.

Study Guide

Chalkboard photographs, comments, reading assignments, problems, and problem solutions. 260 pp. (One per student recommended.)

22-2100 Purchase $11.00 each. (10% Discount on five or more.)

***A Complete Self-Study Subject.** The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.*

Design of IIR Digital Filters (2)
Digital filter design using the bilinear transformation. Frequency warping introduced by the bilinear transformation. Algorithmic design procedures for IIR filters.

41-min. Color Videotape
22-0115 Purchase $335 Rental $34.

Examples of IIR Filter Design
Design of digital Butterworth filter using impulse invariance. Design of digital Butterworth filter using the bilinear transformation. Comparison of the resulting designs.

48-min. Color Videotape
22-0116 Purchase $365 Rental $37.

Design of FIR Digital Filters
Design of FIR filters using windows. Comparison of rectangular, Bartlett and Hamming windows. Frequency sampling method of filter design. Optimum equiripple FIR filters.

39-min. Color Videotape
22-0117 Purchase $325 Rental $33.

Computation of the Discrete Fourier Transform (1)
Direct computation of the discrete Fourier transform. Computation resulting from successive decimation of the sequences. The decimation-in-time form of the fast Fourier transform (FFT) algorithm. Basic butterfly computation.

49-min. Color Videotape
22-0118 Purchase $370 Rental $37.

Computation of the Discrete Fourier Transform (2)
Interpretation of FFT flow graph for in-place computation. Bit-reversed data ordering. Other decimation-in-time FFT algorithms by rearrangement of the flow-graph. Decimation-in-frequency FFT algorithm.

44-min. Color Videotape
22-0119 Purchase $350 Rental $35.

Computation of the Discrete Fourier Transform (3)
Rearrangements of the basic decimation-in-frequency algorithm. Relation between decimation-in-time and decimation-in-frequency through the transposition theorem. Arbitrary radix FFT algorithms.

45-min. Color Videotape
22-0120 Purchase $355 Rental $36.

Economics

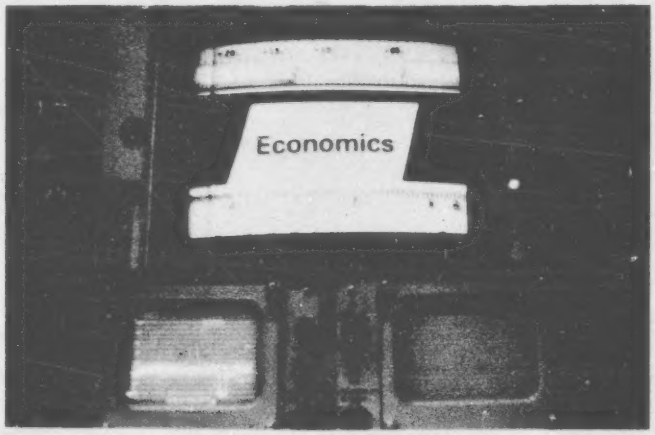
Robert S. Pindyck

Economics is a subject that confronts us every day -- whether we like it or not. National politics, for example, are intertwined with issues of economic policy: Should the federal budget contain a deficit or a surplus and should the Federal Reserve expand or contract the money supply? How can the government deal with problems of inflation and unemployment? These are problems in macroeconomics.

But, pick up a newspaper and you will be confronted with microeconomic issues as well. Should the government tighten its regulation of particular industries? Why do shortages of oil, gasoline, or various foodstuffs occur? These questions can better be understood by one who is familiar with the behavior of consumers, firms, and individual markets.

No previous study of economics is assumed, but a student with a working knowledge of differential calculus will get the most out of this approach to the material.

Robert S. Pindyck is Associate Professor of Management at MIT.



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Economics

Microeconomics

Twelve Color Videotapes

Introduction to the Economic Problem
Production and Exchange in a Small Commune Economy. Introduction to Production Functions, Production-Possibility Frontiers, and Supply and Demand.

55-min. Color Videotape
20-0101 Purchase $385 Rental $39.

Theory of Demand
Introduction to Consumer Demand. The Notion of "Utility". Utility Maximization Subject to a Budget Constraint. Introduction to Indifference Curves, and the Demand Curve of the Individual Consumer.

49-min. Color Videotape
20-0102 Purchase $370 Rental $37.

Consumer Theory and Demand
Behavior of the Demand Curve of the Individual Consumer Under Changing Prices and Income. The Market Demand Curve. Elasticities.

42-min. Color Videotape
20-0103 Purchase $340 Rental $34.

Market Supply and Demand (1)
Introduction to Supply and Demand. Use of Supply-Demand Analysis to Solve a Variety of Economic Problems. Shifts in Demand. Analyzing the Incidence of a Tax.

46-min. Color Videotape
20-0104 Purchase $360 Rental $36.

Market Supply and Demand (2)
Price Regulation. Price Supports and Subsidies. The Concept of Consumer and Producer Surplus, and Its Application to the Evaluation of Government Regulatory Policies.

40-min. Color Videotape
20-0105 Purchase $330 Rental $33.

Production, Cost, and Theory of the Firm (1)
The Theory of the Firm. Internal and External Costs. Production and Cost Minimization. The Calculation of Cost Functions.

46-min. Color Videotape
20-0106 Purchase $360 Rental $36.

Production, Cost, and Theory of the Firm (2)
Short Run and Long Run Cost Curves. Marginal and Average Costs. Marginal and Average Revenues. How the Firm Maximizes Profits.

46-min. Color Videotape
20-0107 Purchase $360 Rental $36.

Introduction to Market Structure - Pure Competition
Behavior of Competitive Firms. The Demand Curve as Seen by an Individual Competitive Firm. The Supply Curve of a Single Competitive Industry. Equilibrium of the Purely Competitive Firm and Industry.

45-min. Color Videotape
20-0108 Purchase $355 Rental $36.

Monopoly

Behavior of Monopolies. Profit Maximization by a Monopoly. Government Regulation of a Monopoly. Taxing a Monopoly.

45-min. Color Videotape
20-0109 Purchase $355 Rental $36.

Topics in Microeconomics (1)

The Structure of American Industry. Monopoly, Oligopoly, and Imperfect Competition. Measuring Monopoly Power. Monopsony and Oligopsony.

44-min. Color Videotape
20-0110 Purchase $350 Rental $35.

Topics in Microeconomics (2)

Factor Demand and Factor Pricing. Market Structure and American Industry. The Performance of American Industry.

48-min. Color Videotape
20-0111 Purchase $365 Rental $37.

Group Discussion on Microeconomics

Round-Table Questions and Discussion.

33-min. Color Videotape
20-0112 Purchase $290 Rental $29.

Macroeconomics

Ten Color Videotapes

Introduction - Gross National Product and Income

Introduction to Macroeconomics. Gross National Product and National Income. National Income Accounting in the United States.

46-min. Color Videotape
20-0201 Purchase $360 Rental $36.

Aggregate Demand (1)

The Behavior of Aggregate Consumption. Aggregate Demand. Disposable Income, Consumption, Savings, and Government Spending. Introduction to the Multiplier.

46-min. Color Videotape
20-0202 Purchase $360 Rental $36.

Aggregate Demand (2)

Taxes and the Balanced Budget Multiplier. Deficit Spending and Fiscal Policy. The Use of Fiscal Policy to Control the Economy.

51-min. Color Videotape
20-0203 Purchase $375 Rental $38.

MICROECONOMICS - Complete Set

Color Videotapes

Complete set of *twelve* Color Videotapes.

20-1100 Purchase $3670 (SAVE $550)
60 Day Rental $382 (SAVE $42)

Suggested Text

No textbook is required for this subject, but Economics by Paul A. Samuelson, (McGraw-Hill) is recommended for students who want an alternative treatment of the subject matter. 917 pp.

20-3100 Purchase $12.95 each.

Study Guide

Summaries, reproductions of overhead transparencies, problems, problem solutions, final exam, and exam solutions. 268 pp. (One per student recommended.)

20-2100 Purchase $11.50 each (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide.

Interest Rates and Investment

Investment Behavior in the United States. Interest Rates and Investment Demand. The Notion of Present Discounted Value, and its Application to Bond Pricing.

54-min. Color Videotape
20-0204 Purchase $385 Rental $39.

Money and Commercial Banking

The Notion of "Money". The Operation of Commercial Banks. Commercial Banking and Money Creation.

42-min Color Videotape
20-0205 Purchase $340 Rental $34.

Federal Reserve System

The Structure and Operation of the Federal Reserve System. How the Federal Reserve System Controls the Money Supply.

45-min. Color Videotape
20-0206 Purchase $355 Rental $36.

Demand and Supply of Money

The Demand for Money in The U.S. Economy. Equilibrium of Money Demand and Supply.

59-min. Color Videotape
20-0207 Purchase $395 Rental $40.

Integration of Monetary and Fiscal Policy

The Integration of Monetary and Fiscal Policy. Introduction to and Use of the IS-LM Apparatus. Monetary and Fiscal Multipliers. The Use of Monetary and Fiscal Policy for Economic Stabilization.

52-min. Color Videotape
20-0208 Purchase $380 Rental $38.

Excess Demand and Inflation

Excess Demand and Inflation. Unemployment. The Inflation-Unemployment Trade Off. Issues in Macroeconomic Policy.

57-min. Color Videotape
20-0209 Purchase $390 Rental $39.

Group Discussion on Macroeconomics

Round-Table Questions and Discussion.

44-min. Color Videotape
20-0210 Purchase $350 Rental $35.

MACROECONOMICS - Complete Set

Color Videotapes

Complete set of of *ten* Color Videotapes

20-1200 Purchase $3245 (SAVE $445)
50 Day Rental $338 (SAVE $33)

Suggested Text

No textbook is required for this subject, but Economics by Paul A. Samuelson, (McGraw-Hill) is recommended for students who want an alternative treatment of the subject matter. 917 pp.

20-3100 Purchase $12.95 each.

Study Guide

Summaries, reproductions of overhead transparencies, problems, problem solutions, final exam, and exam solutions. 152 pp. (One per student recommended.)

20-2200 Purchase $6.50 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide.

Engineering Economy

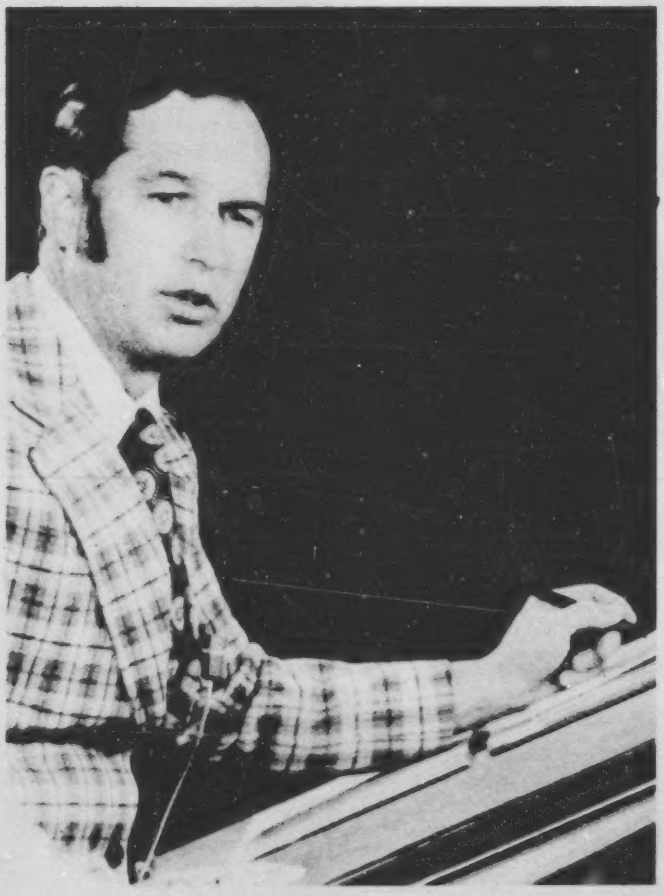
Sanford B. Thayer

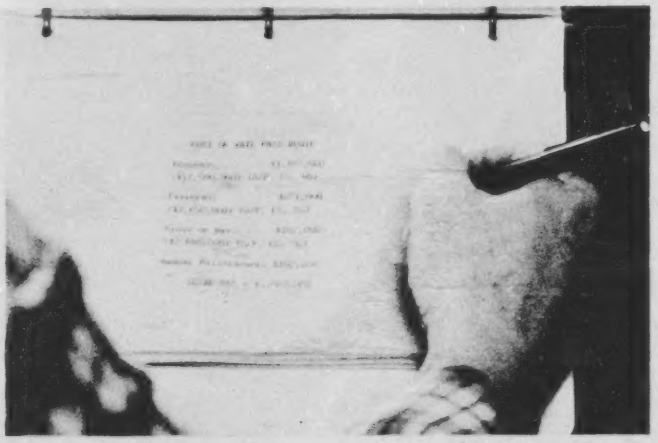
Engineering Economy in concerned with the economic analysis of investment alternatives. Frequently, there are several technically feasible alternatives which will satisfy the functional requirements of the task. But only one of these is the most economically attractive alternative.

A study of Engineering Economy provides students with the concepts and methodology necessary to evaluate the impacts of interest rates, income taxes, and timing of cash flows on the economic attractivenesss of investment proposals.

Many of the topics covered will already be familiar from everyday contact and no mathematics beyond simple arithmetic is used.

Sanford B. Thayer is Associate Professor of Mechanical Engineering at Colorado State University. These materials were prepared at CSU and are offered by MIT as part of a cooperative effort in education.





Engineering Economy

Ten Color Videotapes

Introduction to Engineering Economy
Provides an overview of the course and introduces the concept of "Time Value of Money."

28-min. Color Videotape
23-0101 Purchase $260 Rental $26.

Uniform Annual Cash Flow Method
Introduces the evaluation method which converts all cash flows to a time adjusted equivalent annual amount. The example problem is the economic evaluation of solar energy for residential heating.

23-min. Color Videotape
23-0102 Purchase $220 Rental $22.

Breakeven Analysis
Introduces the concept of break-even to find the point where investments are equally attractive. The example problem is the break-even point of natural gas to make solar energy economically attractive for Solar House I at Colorado State University.

24-min. Color Videotape
23-0103 Purchase $230 Rental $23.

Present Worth Method
Introduces the evaluation method which converts all cash flows to an equivalent amount today. The example problem is present value of a U.S. Treasury Bond.

27-min. Color Videotape
23-0104 Purchase $250 Rental $25.

Rate of Return Method
Introduces the evaluation method which solves for the prospective rate of return on invested capital. The example problem utilizes a share of American Telephone and Telegraph Company common stock as the basis of analysis.

26-min. Color Videotape
23-0106 Purchase $245 Rental $25.

Benefit/Cost Method
Introduces the engineering economy method used by Federal, State, and local governments. The example problem is the Benefit/Cost analysis of the route for Interstate Highway 70, near Vail, Colorado.

25-min. Color Videotape
23-0106 Purchase $240 Rental $24.

ENGINEERING ECONOMY - Complete Set

Color Videotapes

Complete set of *ten* Color Videotapes.

23-1100 Purchase $2100 (SAVE $235)
50 Day Rental $219 (SAVE $16)

Suggested Text

"Principles of Engineering Economy," by E.Grant and W.Ireson, Ronald Press, 1970, 640 pp.

23-3100 Purchase $13.95 each.

Study Guide

Comments, reproductions of all graphics, reading assignments, problems, and problem solutions. 250 pp. (One per student recommended.)

23-2100 Purchase $11.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Cost-Effectiveness Method
Introduces a method of analysis which allows alternatives to be compared on the basis of costs and criteria that cannot necessarily be expressed in monetary terms. The example problem utilizes an economic evaluation of solar energy to produce electrical energy.

25-min. Color Videotape
23-0107 Purchase $240 Rental $24.

Effects of Income Taxes
Introduces the effects of income taxes on engineering economy decisions. The example problem utilizes an evaluation of the economic attractiveness of developing a minimg site compared to selling a lease.

26-min. Color Videotape
23-0108 Purchase $245 Rental $25.

Replacement Studies
Introduces the methodology necessary to calculate the economc time to replace an asset that still has a remaining physical life. The example problem utilizes the replacement of an automobile.

21-min. Color Videotape
23-0109 Purchase $205 Rental $21.

Sources of Funds
The lesson describes the common sources of funds to finance investment projects. The example problem examines the financial statements of a corporation.

20-min. Color Videotape
23-0110 Purchase $200 Rental $20.

Friction, Wear and Lubrication

Ernest Rabinowicz

Friction, Wear and Lubrication is a coherent, up-to-date survey of modern knowledge in this important area. Industry suffers tremendous losses each year because of inefficient practices and ignorance in overcoming friction and wear problems. And it is the aim of this series to provide quantitative information that will be directly applicable to solving these problems.

The major topics covered include the various forms of wear, their characteristics and magnitudes, friction and its laws, the role of lubricants, and such diverse related topics as hardness, surface energy, polishing, and troubleshooting.

The only background required for full appreciation of these lectures and demonstrations is a first-year course in materials and in mathematics.

Ernest Rabinowicz is Professor of Mechanical Engineering at MIT.

Friction, Wear and Lubrication

Twelve Color Videotapes

Tribology
The various topics that constitute the field of tribology and their interrelation. The technical literature. The concept of material hardness and its influence on the area of contact of surfaces.

30-min. Color Videotape
18-0101 Purchase $275 Rental $28.

Wear
Wear, its definition, its place both as a cause of loss of usefulness and a process with many uses. History of wear and description of the various types of wear. Discussion of the surface energy of solids and the energy of adhesion of contacting surfaces.

32-min. Color Videotape
18-0102 Purchase $285 Rental $29.

Adhesive Wear
Presentation of the Archard formulation of the law of adhesive wear, and discussion of earlier work. Extensions and alternative formulations of Archard's equation. Evaluation of steps to be taken to reduce adhesive wear.

43-min. Color Videotape
18-0103 Purchase $345 Rental $35.

Adhesive Particle Size
Derivation of the equations for the size of particles generated in adhesive wear. Experimental confirmation. Influence of particle sizes with respect to surface roughness of sliding surfaces, and importance in determining minimum clearance of bearings.

36-min. Color Videotape
18-0104 Purchase $310 Rental $31.

Abrasive Wear
Derivation of the equation for abrasive wear, and of complications which modify it. Evaluation of abrasive grain and of abrasion-resistant surfaces. Remedies for avoiding or minimizing abrasive wear.

41-min. Color Videotape
18-0105 Purchase $335 Rental $34.

Corrosive Wear
Corrosive wear and its characteristics. Possible benefits if corrosion product is a lubricant. The causes of fretting and the quantitative laws governing material loss during fretting. The mechanism of polishing and of burnishing.

38-min. Color Videotape
18-0106 Purchase $320 Rental $32.

Surface Fatigue Wear
The mechanism of surface fatigue wear and the laws governing it. Discussion of the Weibull distribution, its characteristics and uses. Erosive wear and its laws. The phenomena of fretting fatigue and its effect in reducing strength of structural members.

37-min. Color Videotape
18-0107 Purchase $315 Rental $32.

Friction
The history of friction, with emphasis on the roughness vs. adhesion controversy. The laws of friction and the extent to which they are obeyed. Friction coefficient values and how they are measured. The magnitude of friction-induced temperature increases.

38-min. Color Videotape
18-0108 Purchase $320 Rental $32.

Stick-Slip
The relaxation and harmonic forms of frictional oscillations and how they arise. Conditions for stick-slip and their relation to material properties. Methods of preventing frictional oscillations. Uses of stick-slip.

43-min. Color Videotape
18-0109 Purchase $345 Rental $35.

Lubrication (1)
Fluid lubrication, boundary lubrication, and the types of lubrication in between. Lubricants which form coherent films, and those that reduce the surface energy. Characteristics of solid lubricant film.

43-min. Color Videotape
18-0110 Purchase $345 Rental $35.

Lubrication (2)
Effect of reduction of surface energy on wear, and types of lubricants which are effective in this regard. Petroleum lubricants, synthetic lubricants, E. P. agents and their properties. Automotive lubricants and additives.

45-min. Color Videotape
18-0111 Purchase $355 Rental $36.

Troubleshooting
Systematic procedure for troubleshooting, including determining the characteristics and function of the failed part; examination of its sliding surface; and computation of wear coefficient, temperature rise, and wear particle size. Role of the laboratory test in confirming a diagnosis. Some common tribological problems and methods of curing them.

38-min. Color Videotape
18-0112 Purchase $320 Rental $32.

FRICTION, WEAR AND LUBRICATION - Complete Set

Color Videotapes

Complete set of *twelve* Color Videotapes

18-1100 Purchase $3405 (SAVE $465)
60 Day Rental $356 (SAVE $35)

Suggested Text

Friction and Wear of Materials by Ernest Rabinowicz, John Wiley and Sons, 1965. 244 pp.

18-3100 Purchase $15.95 each.

Study Guide

Photographs, comments, reading assignments, problems, problem solutions, and final exam. 244 pp. (One per student recommended)

18-2100 Purchase $10.50 each. (10% Discount on five or more)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, and Suggested Text.

Introduction to Experimentation

Ernest Rabinowicz

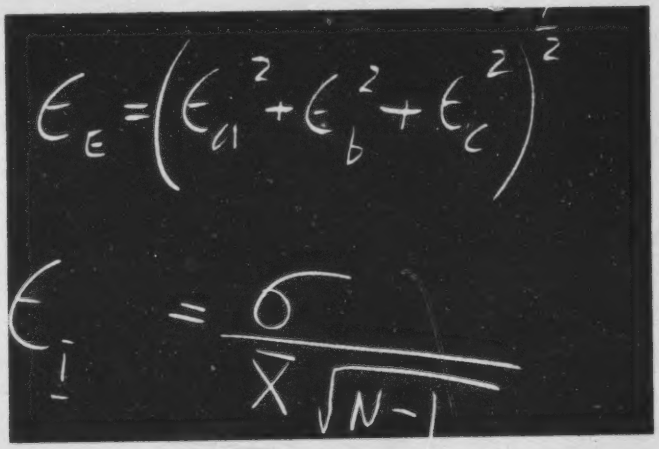
An Introduction to Experimentation is a very practical series of lectures and demonstrations on the designing, carrying out, and reporting of experiments. The topics covered include the characteristics of instruments, errors of measurement, statistical analysis of data, plotting functional relationships, correlation, and technical reporting.

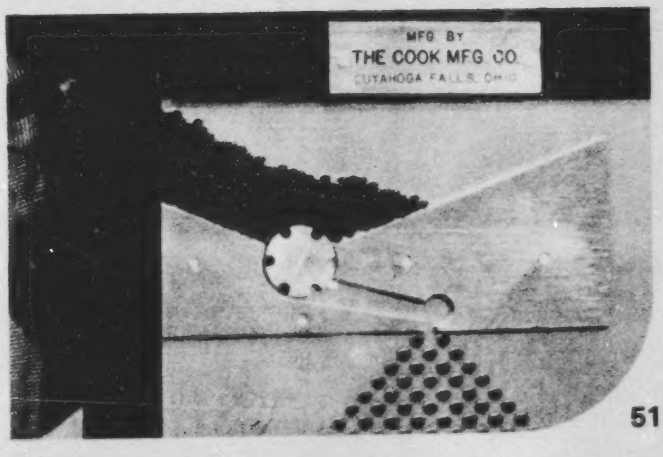
This systematic approach to meaningful experimentation can be applied with great benefit to a wide variety of problems in research and engineering.

Experimentation has been taught for some years at MIT as a technical discipline in its own right.

The mathematical level of this series is not very high; some use is made of calculus in deriving equations, but these can be safely ignored by anyone more interested in application than theory.

Ernest Rabinowicz is Professor of Mechanical Engineering at MIT.





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Introduction to Experimentation

Fourteen B&W 16mm Films or Videotapes

Experimentation
The various steps in an experimental investigation. The history of experimentation. The human senses, their uses, and how they are augmented by measuring instruments. Properties of instruments.

27-min. B&W Film or Videotape
15-0101 Purchase $180 Rental $20.

Resolution of Instruments
Discussion of sensitivity, accuracy and resolution. Application to the problem of measuring foil thickness. Resolution of the microscope in the focal plane and in depth. Sensitivity and resolution of the chemical balance.

32-min. B&W Film or Videotape
15-0102 Purchase $215 Rental $22.

Errors of Measurement
Errors of the caliper micrometer and how they can be minimized. Errors of the moving coil galvanometer and their individual characteristics. Differences between random and systematic errors, unit and proportional errors. Reduction of errors of measurement by balancing or by partial balancing.

37-min. B&W Film or Videotape
15-0103 Purchase $240 Rental $24.

Combination of Errors
Derivation of formula for external error propagation where quantities are multiplied together. Analogy with aiming at a target. Corresponding formula where quantities are added or subtracted. Formulae applied to a caliper micrometer and a speedometer.

30-min. B&W Film or Videotape
15-0104 Purchase $205 Rental $21.

The Normal Distribution
Deviation of the error components for an external error estimate. Error combinations producing distributions of measurements about the mean. The normal distribution and conditions under which it arises. Uses of the normal distribution to estimate extreme values, and to eliminate data.

34-min. B&W Film or Videotape
15-0105 Purchase $225 Rental $23.

Internal Error Estimate
Implications of a non-normal distribution and ways of adjusting it to normalcy. The error of the mean of a normal distribution (standard error) and its magnitude. Formula for internal error.

33-min. B&W Film or Videotape
15-0106 Purchase $220 Rental $22.

Computing the Standard Deviation
Comparison of internal and external error, and the optimum way of combining them. Systematic errors in measuring the velocity of light. Definitions of precision and of accuracy. Method of computing the standard deviation σ outlined, both when number of data points is small and when it is large.

34-min. B&W Film or Videotape
15-0107 Purchase $225 Rental $23.

The χ^2 (Chi-Squared) Test
The χ^2 parameter defined, and adjustment for expended degrees of freedom explained. Use of χ^2 in analysing coin tossing experiments, a normal distribution, and the classic experiments of Mendel.

30-min. B&W Film or Videotape
15-0108 Purchase $205 Rental $21.

The Poisson Distribution
Application of the χ^2 tests to show personal error in estimating final digits. Derivation of the Poisson distribution and explanation of its properties. *Application of the Poisson distribution to the utilization of maternity hospitals.*

31-min. B&W Film or Videotape
15-0109 Purchase $210 Rental $21.

The Best Straight Line
Methods of deriving the best straight line through a set of points. Discussion of the least square method, with special reference to problems arising when the x measurements have substantial error.

29-min. B&W Film or Videotape
15-0110 Purchase $195 Rental $20.

Plotting Other Functions
Resolving choices when a number of plotted functions will give a linear plot. Problem illustrated by plot of track records. Discussion of methods of plotting the exponential function.

32-min. B&W Film or Videotape
15-0111 Purchase $215 Rental $22.

Correlation
Procedures for detecting non-linearity. Plotting a non-linear function. Correlation, rank correlation, and their use. Erroneous results arising from *classification procedures.*

31-min. B&W Film or Videotape
15-0112 Purchase $210 Rental $21.

The Technical Report (1)
Principle laid down that technical report is main method of conveying experimental results, and that title and abstract are sorting devices. Description of the various sections of the report, and comments on do's and don'ts in connection with them.

33-min. B&W Film or Videotape
15-0113 Purchase $220 Rental $22.

The Technical Report (2)
Discussion of satisfactory graphing methods. Peculiar conventions surrounding technical reports - data and pictures are the best, narration has been tidied up. Unacceptable distortions of the technical report - bad data edited out, unconventional ideas suppressed, deliberate falsification.

33-min. B&W Film or Videotape
15-0114 Purchase $220 Rental $22.

INTRODUCTION TO EXPERIMENTATION - Complete Set

Films/Videotapes

Complete set of *fourteen* B&W 16 mm films or videotapes.

15-1100 Purchase $2685 (SAVE $300)
70 Day Rental $276 (SAVE $27)

Suggested Text

An Introduction to Experimentation by E. Rabinowicz, Addison-Wesley, 1970, 124 pp.

15-3100 Purchase $4.95 each.

Study Guide

Photographs, comments, reading assignments, problems, problem solutions, and final exam. 238 pp. (One per student recommended.)

15-2100 Purchase $10.50 each. (10% Discount on five or more)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

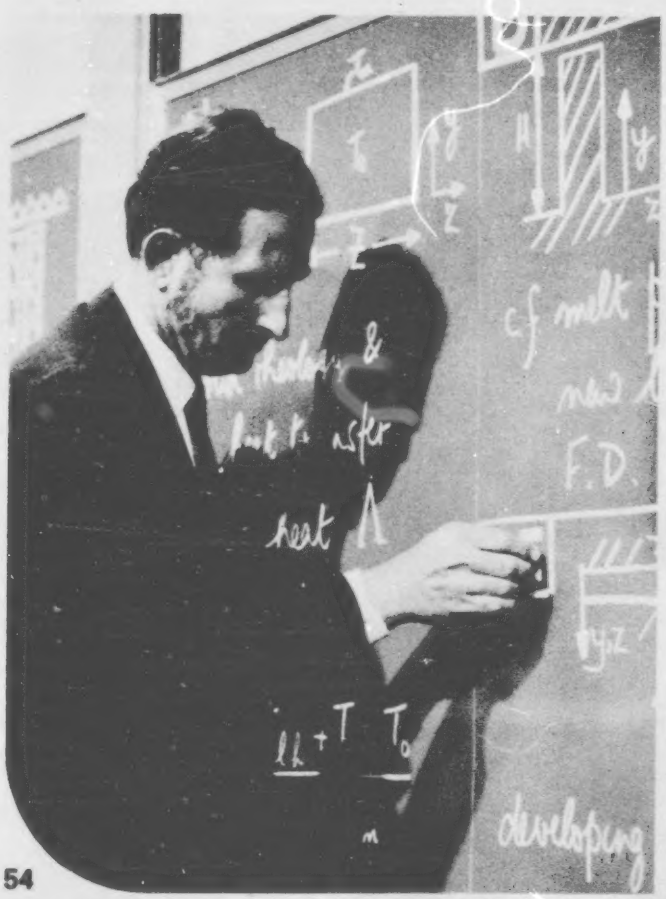
Mechanics of Polymer Processing

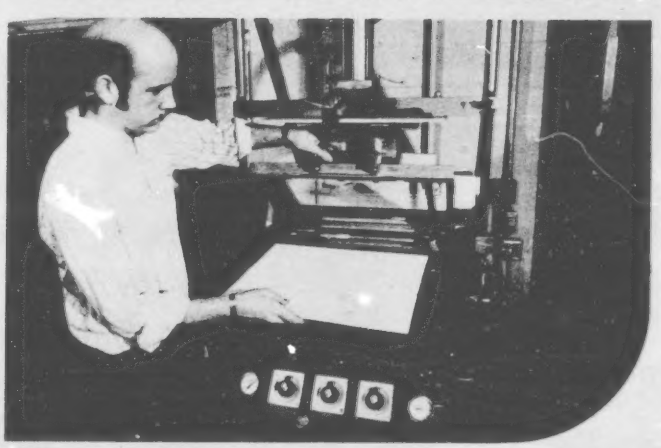
J. R. A. Pearson

Mechanics of Polymer Processing analyzes the mechanical behavior of polymer melts. Processing techniques for these melts have emerged largely on an empirical basis, because their behavior has not been easy to describe. The chemistry and physics of these plastics and elastomers has become increasingly well understood. But their most unusual properties are mechanical , and these vary greatly -- with material, with temperature, and with type of deformation.

The introductory lectures and demonstrations in this series describe the structure and properties of polymers and illustrate some of the important processing techniques. Later lectures concentrate on the fundamental mechanics of visco-elastic materials in terms of mathematical models and the application of these ideas to polymer processes.

J. R. A. Pearson is Professor of Chemical Engineering at Imperial College, University of London.





Mechanics of Polymer Processing

Introduction

Eight Color Videotapes

Materials; Basic Processes
Common commercial polymers by chemical struture; hard or soft, cross-linked or thermoplastic. Geometric variations in products. Thermoplastic processing. Levels of knowledge: molecular, microscopic, continuum.

43-min. Color Videotape
21-0101 Purchase $345 Rental $35.

Physical Properties of Polymers
Molecular concepts: long chains, straight or branched; side groups; copolymers. Statistical descriptions. Crystalline state. Glassy state. Rubbery state. Liquid state. Transitions. Supermolecular effects.

41-min. Color Videotape
21-0102 Purchase $335 Rental $34.

Screw Extrusion of Pipe; Injection Molding
The screw extruder. Continuous operation. Internal mechanism for melting, mixing, pumping. Pipe extrusion through die. A screw pre-plasticized injection molding machine. Cyclic operation. Flow and cooling in mold.

38-min. Color Videotape
21-0103 Purchase $320 Rental $32.

Film Blowing; Blow Molding; Thermoforming; Two-Roll Milling
Biaxial extension of sheet in film blowing. Transient fluctuation in continuous process. Extrusion for blow molding. Cyclic operation of blow mold. Thermal cycle in thermoforming; plunger, vacuum or pressure assisted. Mixing and blending in 2-roll mill. The rolling bank.

41-min. Color Videotape
21-0104 Purchase $335 Rental $34.

INTRODUCTION - Complete Set

Color Videotapes

Complete set of *eight* Color Videotapes

21-1100 Purchase $2460 (SAVE $275)
40 Day Rental $257 (SAVE $19)

Suggested Text

Mechanical Principles of Polymer Melt Processing by J.R.A. Pearson, MIT, 1975, 148 pp.

21-3000 Purchase $5.95 each.

Study Guide

Comments, photographs, reproductions of overhead transparencies, reading assignments, problems, and solutions. 62 pp. (One per student recommended.)

21-2100 Purchase $4.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Kinematics of Flow Processes
Steady and unsteady flows. Confined and free flows. Simple shear flow. Lubrication approximation. Extensional flows, uniaxial and biaxial.

46-min. Color Videotape
21-0105 Purchase $360 Rental $36.

Mathematical Models for Flow Processes
Fundamental laws. Field variables. Approximations. Rheological equations of state. Uniaxial extensional flow dynamics. Steady simple shear dynamics.

40-min. Color Videotape
21-0106 Purchase $330 Rental $33.

Stability of Flow Processes
Non-uniform and unstable flow. Time and space fluctuations. Tube and channel flow instabilities; entry, exit and parallel flow effects. Sheet drawing instability.

43-min. Color Videotape
21-0107 Purchase $345 Rental $35.

Control and Design of Flow Processes
Control of existing processes. Shape and property fluctuations. Control variables. Film blowing as example. Surging in extruders. Die design. Need for fundamental information. Quality control. The design process. Cost criterion.

48-min. Color Videotape
21-0108 Purchase $365 Rental $37.

Fundamentals of Polymer Melt Mechanics

Twelve Color Videotapes

General Rheological Properties
Description of solid, fluid, viscoelastic solid, elastico-viscous liquid; types of uniform deformation; simple one-dimensional models.

49-min. Color Videotape
21-0201 Purchase $370 Rental $37.

Continuum Approach. Stress & Deformation
Orthogonal coordinate systems; the nature of stress - a tensor; displacement and deformation - the strain, rate-of-strain and vorticity tensors.

49-min. Color Videotape
21-0202 Purchase $370 Rental $37.

Conservation Laws & Constitutive Relations
Conservation of mass, momentum and energy; rheological equations of state: elastic, viscous, viscoelastic.

47-min. Color Videotape
21-0203 Purchase $360 Rental $36.

Experimental Investigations
Density; specific heat; thermal conductivity. Extrusion and shear rheology. Experimental results for typical polymers.

47-min. Color Videotape
21-0204 Purchase $360 Rental $36.

Viscometric Flow
Simple shear flow; the cone-and-plate viscometer; other methods. Viscosity and normal stress differences.

46-min. Color Videotape
21-0205 Purchase $360 Rental $36.

Irrotational Flows
Uniaxial extensional flow; pure shear flow; biaxial extensional flow; extensional viscosity and other rheological functions.

42-min. Color Videotape
21-0206 Purchase $340 Rental $34.

Dynamic Viscosity
Complex modulus; values for simple models; time-temperature superposition. Linear and non-linear viscoelastic models.

46-min. Color Videotape
21-0207 Purchase $360 Rental $36.

Unsteady Flows
Die swell; elastic recovery; melt fracture and flow instability.

56-min. Color Videotape
21-0208 Purchase $390 Rental $39.

Basic Solution: Confined Flow (1)
Pressure flow in uniform channel; flow calculations for known fluid; channel flow as rheological measurement.

41-min. Color Videotape
21-0209 Purchase $335 Rental $34.

Basic Solution: Confined Flow (2)
General uniform channel flow between parallel flat moving plates.

43-min. Color Videotape
21-0210 Purchase $345 Rental $35.

The Lubrication Approximation
General theory; simple example of wedge flow; applications.

40-min. Color Videotape
21-0211 Purchase $330 Rental $33.

Thin Sheet Approximations
General Theory; continuity and stress equilibrium equations; flat sheet flow; simple plane flow example; applications.

44-min. Color Videotape
21-0212 Purchase $350 Rental $35.

Application to Polymer Processing

Twelve Color Videotapes

Introduction
Objectives of polymer processing - geometrical, physical and chemical; control of process; importance of thermal history; types of process - confined and free flows.

49-min. Color Videotape
21-0301 Purchase $370 Rental $37.

Temperature Effects in Confined Flows
The lubrication approximation; simple example of plane flow; dimensionless groups; scale temperatures and process variables.

47-min. Color Videotape
21-0302 Purchase $360 Rental $36.

FUNDAMENTALS - Complete Set

Color Videotapes

Complete set of *twelve* Color Videotapes.

21-1200 Purchase $3845 (SAVE $575)
60 Day Rental $400 (SAVE $44)

Suggested Text

Mechanical Principles of Polymer Melt Processing by J.R.A. Pearson, MIT, 1975, 148 pp.

21-3000 Purchase $5.95 each.

Study Guide

Comments, photographs, reproductions of overhead transparencies, reading assignments, problems, and solutions. 112 pp. (One per student recommended.)

21-2100 Purchase $5.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a completed self-study subject when accompanied by the Study Guide and Suggested Text.

Flow in Dies
Forms of extrudate; symmetrical extrudates; quantitative analysis; use of dimensionless variables; simple example; instability in die flow.

47-min. Color Videotape
21-0303 Purchase $360 Rental $36.

Single Screw Extruder: Metering Zone
The extruder overall; geometrical simplifications; velocity profiles; dimensionless groups; approximate theories; numerical solutions and computer programs.

47-min. Color Videotape
21-0304 Purchase $360 Rental $36.

Single Screw Extruder: Melting Zone
Basic models; the plug-pool model with its five zones - solid bed, melt pool, swept melting layer and growing lubricating layers; mass and stress balances; surging.

57-min. Color Videotape
21-0305 Purchase $390 Rental $39.

Single Screw Extruder: Feed Zone; Scale-up
Solid plug models; complete model for plasticating extruders; scaling-up extruders.

57-min. Color Videotape
21-0306 Purchase $390 Rental $39.

Fiber Spinning: General
One dimensional model; conservation equations; dimensionless representation and groups; steady-state equations; boundary conditions.

47-min. Color Videotape
21-0307 Purchase $360 Rental $36.

Fiber Spinning: Stability
Linearized perturbation analysis; Fourier decomposition; sensitivity analysis for various imposed disturbances; stability analysis and draw resonance.

52-min. Color Videotape
21-0308 Purchase $380 Rental $38.

Film Blowing: Steady-State Symmetric
Steady axisymmetric flow; geometrical approximations; balance equations for mass, force and energy; rheological relations; purely viscous model; extensions.

48-min. Color Videotape
21-0309 Purchase $365 Rental $37.

APPLICATIONS - Complete Set

Color Videotapes

Complete set of *twelve* Color Videotapes.

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Suggested Text

Mechanical Principles of Polymer Melt Processing by J.R.A. Pearson, MIT, 1975, 148 pp.

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Study Guide

Step-by-step path through the material with summaries of the lectures, photographs, problems and problem solutions. 108 pp. (One per student recommended.)

21-2300 Purchase $4.50 each.
(10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Film Blowing: Stability. Film Casting
Linearized analysis for sensitivity and stability of viscous film-blowing model; unsteady axisymmetric and steady non-axisymmetric disturbances. Kinematic model for film casting; growth of edge bead; linearized sensitivity and stability analysis.

48-min. Color Videotape
21-0310 Purchase $365 Rental $36.

Calendering
Narrow channel approximation; simple plane flow equations; difficulty in specifying inlet and exit boundary conditions; mixing; load on rolls; instability.

43-min. Color Videotape
21-0311 Purchase $345 Rental $35.

Injection Molding
General remarks on process; flow in molds - unsteady and high pressure drop; simple example of disc mold; flow equations; freezing; complexity of rheological forces involving simple shear and irrotational distortion; instability of flow.

51-min. Color Videotape
21-0312 Purchase $375 Rental $38.

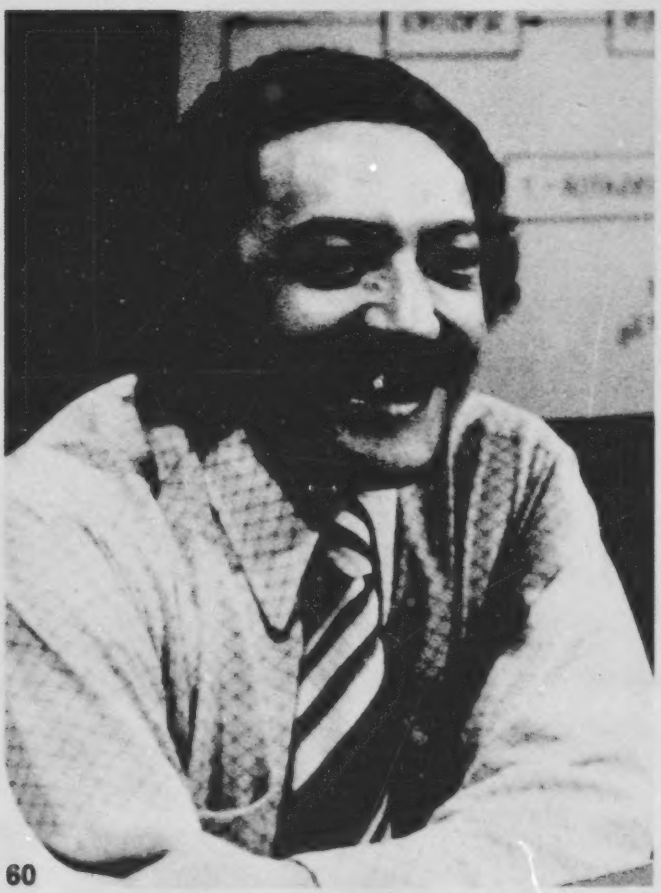
Modern Control Theory

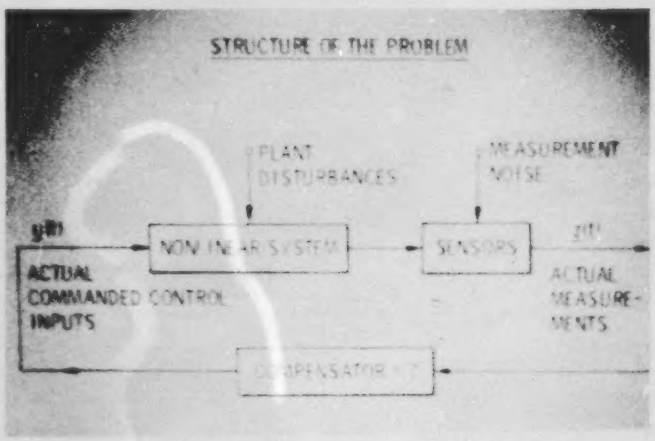
Michael Athans

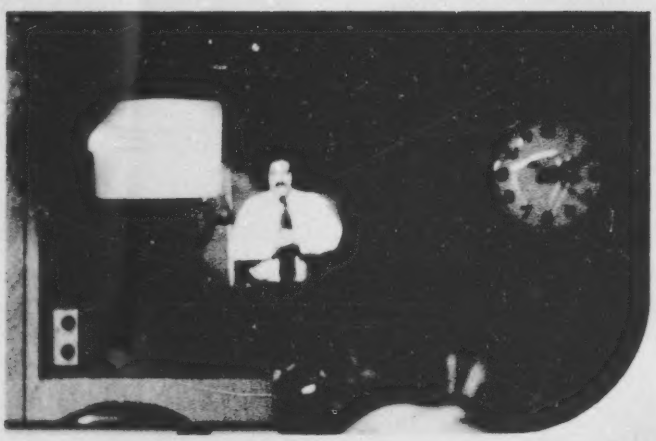
Modern Control Theory is an engineering discipline which deals with specific analytical and algorithmic methods which can be used to control complex stochastic dynamic systems so as to optimize their performance. These tools have found wide applicability in aerospace and defense systems, industrial control systems, transportation systems, biological systems, power systems, and socio-economic systems.

In addition to the theory, a set of computer subroutines has been developed to analyze an important class of practical problems and to design suitable control systems. The basic pre-requisite for these lectures and demonstrations is a working knowledge of vectors and matrices and their operations as well as an exposure to the notion of eigenvalues and eigenvectors.

Michael Athans is Professor of Electrical Engineering and Computer Science at MIT and Director of the Electronic Systems Laboratory.







Modern Control Theory

System Analysis

Eleven Color Videotapes

Introduction to Optimal Control and Estimation Methods (1)
Overview of philosophy of modern control. Definition of deterministic optimal control, stochastic estimation, and stochastic control.

49-min. Color Videotape
19-0001 Purchase $370 Rental $37.

Introduction to Optimal Control and Estimation Methods (2)
Block diagram description of final engineering design using the methods of modern control theory.

36-min. Color Videotape
19-0002 Purchase $310 Rental $31.

The General Notion of the State of a Dynamical System
Introduction of state variables in an input-output representation. Input-state-output description of lumped systems using vector differential or difference equations.

45-min. Color Videotape
19-0101 Purchase $355 Rental $36.

Linear Continuous Time Dynamical Systems
Systems described by linear, constant or time-varying, vector differential equations. Solution methods; the state transition matrix and the matrix exponential. Forced and unforced solutions.

42-min. Color Videotape
19-0102 Purchase $340 Rental $34.

SYSTEM ANALYSIS - Complete Set

Color Videotapes

Complete set of *eleven* Color Videotapes.

19-1100 Purchase $3295 (SAVE $450)
55 Day Rental $342 (SAVE $34)

Suggested Text

Optimal Control, by M. Athans and P.L. Falb, McGraw-Hill, 1966, 879 pp.

19-3100 Purchase $21.00 each.

Computer Manual

An especially written manual of computer subroutines. 208 pp.

19-4000 Purchase $9.00 each.
(10% Discount on five or more.)

Computer Card Deck

Set of punched cards in Fortran for implementing programs described in Computer Manual.

19-5000 Purchase $40.00 each.

Study Guide

Reproductions of overhead transparencies, comments, readings, problems and problem solutions. 192 pp. (One per student recommended.)

19-2100 Purchase $8.50 each.
(10% Discount on five or more.)

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Computer Manual, and Suggested Text.

Dynamic Linearization for Continuous Time Systems
The notion of a nominal trajectory for nonlinear systems. Perturbation methods and Taylor series expansions for vector-valued nonlinearities. The linear dynamic perturbation model.

27-min. Color Videotape
19-0103 Purchase $250 Rental $25.

Discrete-Time Dynamical Systems
Perturbation and dynamic linearization methods for systems described by nonlinear vector difference equations.

40-min. Color Videotape
19-0104 Purchase $330 Rental $33.

Linear Time Invariant Dynamical Systems
Review of eigenvalues and eigenvectors; their role in the expression of solutions of linear differential and difference equations. Definition of, and tests for, stability.

52-min. Color Videotape
19-0105 Purchase $380 Rental $38.

The Relation of Transfer Functions and State Variable Representations
Review of Laplace transforms for scalars, vectors, and matrices. Techniques for obtaining the transfer matrix and transfer function from state space representations. Relationships of poles, zeros, and matrix eigenvalues.

53-min. Color Videotape
19-0106 Purchase $380 Rental $38.

From Transfer Functions to State Variable Representations
Systematic techniques for transforming a transfer function to different state variable realizations. Illustrations using analog computer diagrams.

41-min. Color Videotape
19-0107 Purchase $335 Rental $34.

Controllability and Observability
Definitions and tests for controllability and observability. Physical interpretation of these fundamental concepts.

50-min. Color Videotape
19-0108 Purchase $375 Rental $38.

Computer Routines for Linear System Analysis
Use of computer subroutines for calculating solutions of linear dynamic systems. A helicopter example.

38-min. Color Videotape
19-0109 Purchase $320 Rental $32.

Deterministic Optimal Control

Ten Color Videotapes

General Discussion
Motivation for optimal control problems. Counterintuitive examples. Relevance of scalar valued criteria for performance.

49-min. Color Videotape
19-0201 Purchase $370 Rental $37.

The Minimum Principle of Pontryagin: Continuous Time Case
Statement of the Pontryagin minimum principle for different formulations of optimal control problems.

49-min. Color Videotape
19-0202 Purchase $370 Rental $37.

The Dynamic Programming Algorithm
Discrete-time optimal control problems. The principle of optimality. Bellman's dynamic programming algorithm and its implementation.

60-min. Color Videotape
19-0203 Purchase $395 Rental $40.

The Minimum Principle: Discrete Time Case
Discrete optimal control problems and the associated minimum principles for their solutions.

43-min. Color Videotape
19-0204 Purchase $345 Rental $35.

The Steepest Descent Method
Description of a "simple" digital computer algorithm to solve deterministic optimal control problems.

84-min. Two Color Videotapes
19-0205 Purchase $555 Rental $60.

Numerical Example: Solution of a Minimum Fuel Problem in the Apollo Project
Illustration of the steepest descent method to solve an orbit transfer problem involving the Apollo SSV orbiter stage.

21-min. Color Videotape
19-0206 Purchase $210 Rental $21.

Newton's Method
General philosophy of the Newton or quasilinearization method. Reduction of minimum principle equations to the two-point-boundary value problem, and their iterative solution using Newton's method.

83-min. Two Color Videotapes
19-0207 Purchase $500 Rental $50.

Minimum Principle vs Dynamic Programming
Contrast from a technical and algorithmic viewpoint of the two methods for solving optimal control problems. Open-loop vs closed-loop optimal controls.

50-min. Color Videotape
19-0208 Purchase $375 Rental $38.

Deterministic Optimal Linear Feedback

Twenty-one Color Videotapes

Motivation for the Linear-Quadratic Problem
Detailed motivation for using quadratic performance criteria for the optimal control of the linearized perturbational dynamics about a nominal trajectory associated with a nonlinear system. The nature of the optimal linear-quadratic solution; state perturbation linear feedback.

73-min. Two Color Videotapes
19-0301 Purchase $480 Rental $48.

The Solution of the Linear-Quadratic Problem
Statement of the Linear-Quadratic problem for both continuous and discrete time systems. Solution methods via Riccati equations. Summary of off-line and on-line computations.

47-min. Color Videotape
19-0302 Purchase $360 Rental $36.

DETERMINISTIC OPTIMAL CONTROL - Complete Set

Videotapes

Complete set of *ten* Color Videotapes.

19-1200 Purchase $2745 (SAVE $375)
50 Day Rental $289 (SAVE $29)

Suggested Text

Optimal Control, by M. Athans and P.L. Falb, McGraw-Hill, 1966, 879 pp.

19-3200 Purchase $21.00 each.

Study Guide

Reproductions of overhead transparencies, comments, readings, problems and problem solutions. 306 pp. (One per student recommended.)

19-2200 Purchase $13.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, and Suggested Text.

Motivation for the Steady-State Linear-Quadratic Problem
Static linearization; state-input equilibria and their optimal calculation. Formulation of the optimal dynamic control problem using linearized perturbation dynamics.

104-min. Three Color Videotapes
19-0303 Purchase $885 Rental $89.

The Steady-State Linear-Quadratic Problem: Continuous-Time Case
Problem definition and the nature of the optimal solution via the algebraic Riccati equation. Constant gain state variable feedback designs and their guaranteed stability.

51-min. Color Videotape
19-0304 Purchase $375 Rental $38.

The Steady-State Linear-Quadratic Problem: Discrete Time Case
The optimal control of linear discrete-time systems with respect to quadratic performance indices over an infinite time horizon. The discrete algebraic Riccati equation. Stability of the closed loop designs.

38-min. Color Videotape
19-0305 Purchase $320 Rental $32.

The Steady-State Linear-Quadratic Problem with Deterministic Disturbances
Modeling of exogeneous disturbances using uncontrollable state variable models. Solution of the regulation problem. Influence of the disturbances in the overall control structure and their decoupling in the control system design.

41-min. Color Videotape
19-0306 Purchase $335 Rental $34.

Control of Helicopter at Hover
Problem formulation and solution for the design of an autopilot to keep a helicopter at a desired hovering condition. How to select the performance index for physical problems.

31-min. Color Videotape
19-0307 Purchase $280 Rental $28.

Programs: Helicopter Example
Use of the computer subroutines to solve for the optimal feedback gain for a helicopter hovering problem.

40-min. Color Videotape
19-0308 Purchase $330 Rental $33.

DETERMINISTIC OPTIMAL LINEAR FEEDBACK - Complete Set

Color Videotapes

Complete set of *twenty-one* Color Videotapes.

19-1300 Purchase $5505 (SAVE $890)
100 Day Rental $572 (SAVE $70)

Suggested Text

Optimal Control, by M. Athans and P. Falb, McGraw Hill, 1966, 878 pp.

19-3100 Purchase $20.00 each.

Computer Manual

An especially written manual of computer subroutines. 208 pp.

19-4000 Purchase $9.00 each. (10% Discount on five or more.)

Computer Card Deck

Set of punched cards in Fortran for implementing programs described in Computer Manual.

19-5000 Purchase $40.00 each.

Study Guide

A step-by-step path through the material with viewgraph reproductions, comments, exercises, and solutions. 305 pp. (One per student recommended.)

19-2300 Purchase $13.50 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Computer Manual and Suggested Text.

The Steady-State Linear Regulator Problem for Constant Disturbances
Proper formulation of the optimization problem for the design of linear quadratic regulators in the presence of constant disturbances. The need to incorporate a penalty on the control rates in the cost functional. The existence of integrators in the optimal feedback design.

70-min. Two Color Videotapes
19-0309 Purchase $465 Rental $47.

Design of Proportional-Derivative-Integral Controllers for Tracking Step Inputs
Appropriate formulation of optimal linear-quadratic designs that can follow multivariable step inputs with zero steady-state error. Realization using state integral feedback plus proportional and integral channels on the vector error signals.

44-min. Color Videotape
19-0310 Purchase $350 Rental $35.

Asymptotic Behavior of Steady-State Linear-Quadratic Closed-Loop Systems
General properties of optimal linear-quadratic designs on the weights in the cost functional charge; motion of the optimal closed loop poles in the s-plane. Effect of minimum and non-minimum phase zeros.

77-min. Two Color Videotapes
19-0311 Purchase $510 Rental $51.

Optimal Control of a Macro-economic Model of the U.S. Economy (1957-1962)
An economic example of using optimal linear-quadratic optimal feedback control strategies to control, in different ways, a model of the U.S. economy developed by R.S. Pindyck.

44-min. Color Videotape
19-0312 Purchase $350 Rental $35.

Air Traffic Control in the Near Terminal Area
A numerical example that illustrates how the solution of three distinct optimization problems can be used to obtain optimal path stretching and route control strategies to land aircraft under both normal and emergency conditions.

152-min. Three Color Videotapes
19-0313 Purchase $1000 Rental $100.

Computer Routines for Deterministic Optimal Linear Feedback
Use of computer subroutines for computing the solution to the steady-state linear-quadratic problem. A helicopter example.

45-min. Color Videotape
19-0314 Purchase $355 Rental $36.

Stochastic Estimation

Twenty Color Videotapes

Introduction
Definition of the stochastic estimation problem. Physical problems. Mathematical models. Colored and white noise models.

47-min. Color Videotape
19-0401 Purchase $360 Rental $36.

Review of Probabilistic Concepts
Random variables; expected values, variances, covariances, and correlations. Joint and conditional probabilities, conditional expectations and covariances. Extension of concepts to vector and matrix valued random variables.

50-min. Color Videotape
19-0402 Purchase $375 Rental $38.

Response of Linear Systems to White Noise Inputs: Discrete Time Case
Discrete white noise. Open loop mean and covariance propagation for systems described by vector difference equations. Transient and steady behavior. Prediction and forecasting.

46-min. Color Videotape
19-0403 Purchase $360 Rental $36.

Response of Linear Systems to White Noise Inputs: Continuous Time Case

Open-loop prediction and forecasting for systems described by linear vector differential equations. Dynamic evolution of means and covariance matrices. Steady state considerations.

52-min. Color Videotape
19-0404 Purchase $380 Rental $38.

The Bayesian Approach to Parameter Estimation

Prior and posterior information. Mathematical modeling of multivariable static experiments. Bayes rule and the relation of prior and posterior (conditional) probability density functions. Linear-gaussian estimation problems. Formulas that determine the updated means and covariance matrices.

90-min. Two Color Videotapes
19-0405 Purchase $595 Rental $60.

The Discrete-Time Kalman Filter

Formulation of the state estimation problem for linear discrete-time dynamic systems described by stochastic vector difference equations, given noisy measurements of linear combinations of state variables. The discrete Kalman filter; predict and update formulas for the conditional mean of the state and covariance matrices.

86-min. Two Color Videotapes
19-0406 Purchase $570 Rental $57.

Effect of Changing Covariance Matrix of Measurement upon a Kalman Filter

A four dimensional numerical example that illustrates dynamic evolution of error covariances as a function of number of measurements and of the value of the measurement covariance matrix.

36-min. Color Videotape
19-0407 Purchase $310 Rental $31.

STOCHASTIC ESTIMATION - Complete Set

Color Videotapes

Complete set of *twenty* Color Videotapes.

19-1400 Purchase $5725 (SAVE $925)
95 Day Rental $596 (SAVE $73)

Suggested Text

Applied Optimal Estimation by A. Gelb, MIT Press, 1974, 374 pp.

19-3400 Purchase $7.95 each.

Computer Manual

An especially written manual of computer subroutines. 208 pp.

19-4000 Purchase $9.00 each. (10% Discount on five or more.)

Computer Card Deck

Set of punched cards in Fortran for implementing programs described in Computer Manual.

19-5000 Purchase $40.00 each.

Lecture Notes

To be published. Write for price and information.

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Lecture Notes, Computer Manual, and Suggested Text.

The Continuous Time Kalman-Bucy Filter
Definition of the state estimation problem for stochastic dynamic systems described by linear time-varying vector differential equations, given linear measurements of the state variables in the presence of additive measurement noise. The Kalman-Bucy filter; the Riccati equation for dynamic propagation of the error covariance matrix.

48-min. Color Videotape
19-0408 Purchase $365 Rental $37.

The Steady-State Kalman-Bucy Filter: Continuous Time Case
Asymptotic behavior of the Kalman-Bucy filter under assumptions of time-invariant dynamics and stationary noise statistics. Stability properties. The algebraic Riccati equation.

48-min. Color Videotape
19-0409 Purchase $365 Rental $37.

Steady-State Programs: Helicopter Example
Description of the digital computer subroutines for solution of steady-state Kalman-Bucy filtering problems, and the stochastic simulation of the resulting system. An illustrative example using helicopter dynamics.

40-min. Color Videotape
19-0410 Purchase $330 Rental $33.

A Visualization of Kalman Filtering
An illustrative example using computer generated graphics of the Kalman filter using a doubly hinged pendulum.

40-min. Color Videotape
19-0411 Purchase $330 Rental $33.

The Steady-State Kalman Filter: Discrete Time Case
Asymptotic behavior of the discrete Kalman filter for time-invariant systems and stationary noise statistics. Constant gain realizations. Stability properties.

43-min. Color Videotape
19-0412 Purchase $345 Rental $35.

Numerical Example: Estimation of positions, velocities, and accelerations
A numerical example using constant acceleration inertial dynamics to illustrate the structure and accuracy of the Kalman-Bucy filter.

32-min. Color Videotape
19-0413 Purchase $285 Rental $29.

Numerical Example: Sensor Tradeoffs
Illustration of using the Kalman filtering theory for deciding the best sensor to use for fixed dynamics.

47-min. Color Videotape
19-0414 Purchase $360 Rental $36.

Suboptimal Nonlinear Filtering Algorithms: Discrete-Time
Definition of nonlinear estimation problem. Computational difficulties of optimal estimation algorithm. Suboptimal algorithms: the extended Kalman filter. Real time computational requirements.

87-min. Two Color Videotapes
19-0415 Purchase $575 Rental $58.

Numerical Example: Estimation of position, velocity, and ballistic parameter for a vertical re-entering body
Numerical example illustrating how bias estimation errors associated with the use of an extended Kalman filter, can be removed through the use of a second order filter.

47-min. Color Videotape
19-0416 Purchase $360 Rental $36.

Computer Routines for Linear Stochastic Estimation
Use of computer routines to design and simulate the steady-state Kalman-Bucy filter. A helicopter example.

54-min. Color Videotape
19-0417 Purchase $385 Rental $39.

Stochastic Control

Sixteen Color Videotapes

Introduction
Overview of stochastic control problem. Typical application areas. General discussion of stochastic optimal control problems and of their solution.

40-min. Color Videotape
19-0501 Purchase $330 Rental $33.

The General Problem
Precise formulation of optimal stochastic control problems for nonlinear dynamical systems described by discrete-time stochastic vector difference equations. Stochastic dynamic programming. Conditional expectations and the classical information pattern. Computational difficulties.

89-min. Two Color Videotapes
19-0502 Purchase $590 Rental $59.

The Discrete-Time Linear-Quadratic-Gaussian (LQG) Problem
Optimal stochastic control for linear time-varying stochastic systems described by vector difference equations and noisy measurements. The Gaussian assumption. Quadratic criteria. The separation theorem. The optimal linear feedback compensator. Analysis of the optimal cost-to-go.

83-min. Two Color Videotapes
19-0503 Purchase $580 Rental $58.

The Continuous-Time Linear-Quadratic-Gaussian (LQG) Problem
Formulation and solution of the optimal stochastic control problem for linear time-varying dynamic systems described by stochastic vector differential equations. Quadratic performance criteria. Gaussian random processes. The separation theorem. The structure of the optimal linear feedback dynamic compensator. The control and filtering matrix Riccati equations.

87-min. Two Color Videotapes
19-0504 Purchase $575 Rental $58.

STOCHASTIC CONTROL - Complete Set

Color Videotapes

Complete set of *sixteen* Color Videotapes.

19-1500 Purchase $4270 (SAVE $640)
75 Day Rental $442 (SAVE $49)

Computer Manual

An especially written manual of computer subroutines. 208 pp.

19-4000 Purchase $9.00 each.
(10% Discount on five or more.)

Computer Card Deck

Set of punched cards in Fortran for implementing programs described in Computer Manual.

19-5000 Purchase $40.00 each.

Lecture Notes

To be published. Write for price and information.

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Lecture Notes and Computer Manual.

Numerical Example of LQG Design for a Third Order Continuous Time System
The numerical characterization of the optimal LQG dynamic compensator for a specific numerical example.

27-min. Color Videotape
19-0505 Purchase $250 Rental $25.

Systematic Procedures and Numerical Example
Numerical solution of a fourth order continuous time LQG example. Structure of resulting optimal dynamic compensator.

38-min. Color Videotape
19-0506 Purchase $320 Rental $32.

Control of a Nonlinear System About Desired Time Varying Trajectory
Step-by-step procedures for the suboptimal stocnastic control of nonlinear systems described by stochastic vector differential equations. The blending of open-loop optimal controls and LQG designed feedback compensators.

52-min. Color Videotape
19-0507 Purchase $380 Rental $38.

The Steady State LQG Problem: Continuous Time Case
Formulation and solution of the optimal stochastic control problem for linear time-invariant dynamic systems with respect to quadratic performance criteria and with stationary Gaussian noises. The linear time-invariant LQG feedback compensator and the separation property of the closed loop poles. Rules of thumb for design.

68-min. Two Color Videotapes
19-0508 Purchase $450 Rental $45.

Steady State Theory Computer Programs: Helicopter Example
Description of the computer subroutines that solve and simulate steady state LQG designs. Illustration using a helicopter example.

57-min. Color Videotape
19-0509 Purchase $390 Rental $39.

Control of a Nonlinear System about Desired Constant Equilibrium
Step-by-step procedures for the suboptimal design of a control system for maintaining a time invariant nonlinear dynamic system about a desired constant input-state equilibrium.

39-min. Color Videotape
19-0510 Purchase $325 Rental $33.

Optimal Control of the F-8 Aircraft
Visualization of LQG based control of the longitudinal dynamics of the F-8 aircraft, subject to wind gusts, using computer generated images.

40-min. Color Videotape
19-0511 Purchase $330 Rental $33.

Computer Routines for Linear Stochastic Control
Use of computer routines to design and simulate the steady-state stochastic regulator using the LQG approach.

57-min. Color Videotape
19-0512 Purchase $390 Rental $39.

Network Analysis and Design

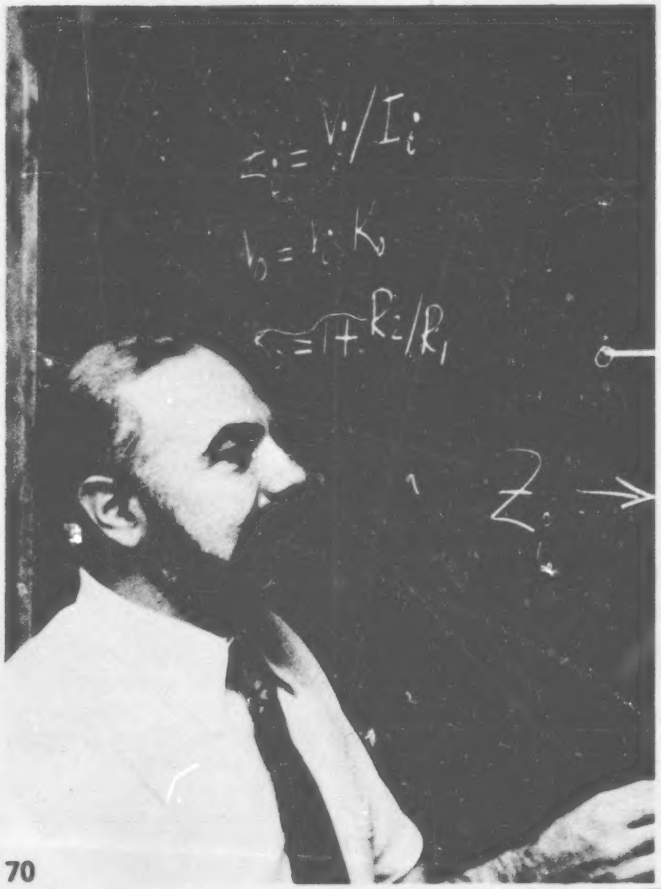
Aram Budak

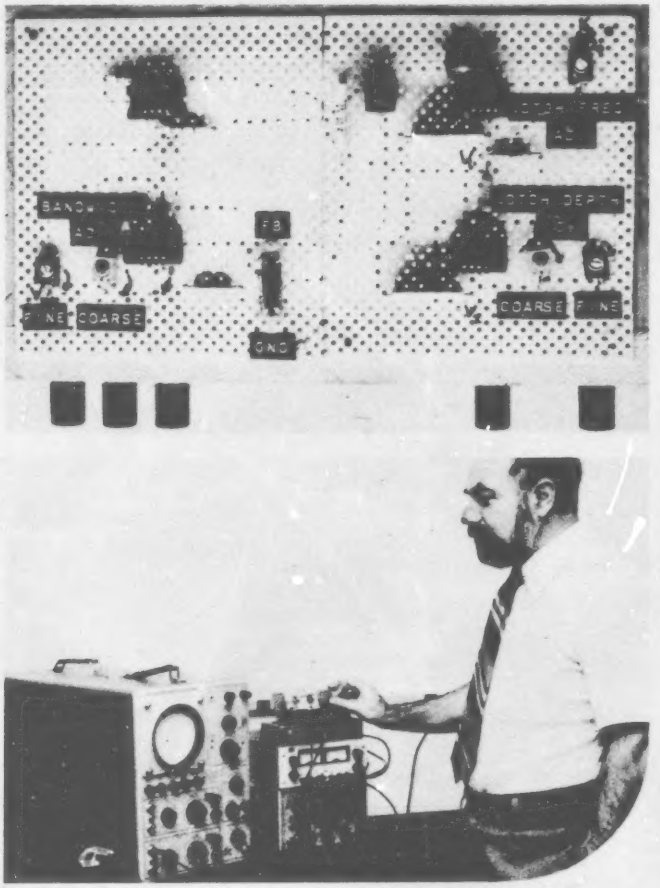
Network Analysis and Design in the Frequency Domain is intended for circuit designers who want to learn about modern operational amplifiers. The first set of lectures and demonstrations develops a number of useful circuit analysis techniques and applies these to a large number of sample problems.

In the second set, RC-operational amplifier circuits are discussed. Ideal and one-pole rolloff modeling of operational amplifiers are used to study the characteristics of many practical circuits.

This course assumes knowledge of Laplace transformation and fundamentals of circuit theory.

Aram Budak is Professor of Electrical Engineering at Colorado State University. These materials were prepared at CSU and are offered by MIT as part of a cooperative effort in education.





Network Analysis and Design

The Frequency Domain

Eight Color Videotapes

Useful Circuit Analysis Techniques (1)
Discussion and application of the principle of superposition.

33-min. Color Videotape
24-0101 Purchase $290 Rental $29.

Useful Circuit Analysis Techniques (2)
Determination of equivalent circuits.

32-min. Color Videotape
24-0102 Purchase $215 Rental $22.

Dependent Sources
Analysis techniques involving dependent sources.

40-min. Color Videotape
24-0103 Purchase $330 Rental $33.

The System Function
Discussion of poles, zeros, and system functions.

43-min. Color Videotape
24-0104 Purchase $345 Rental $35.

Ladder Networks
RC, RL, LC, and Parallel Ladder Structures.

49-min. Color Videotape
24-0105 Purchase $370 Rental $37.

Natural and Forced Response
Decomposition of the response into its natural and forced components. Demonstration of the two components of the response.

39-min. Color Videotape
24-0106 Purchase $325 Rental $33.

Step and Sinusoidal-Steady-State Response
Calculation of step and sinusoidal response of networks.

36-min. Color Videotape
24-0107 Purchase $310 Rental $31.

Magnitude and Phase
Determination and interpretation of magnitude and phase characteristics. Demonstration of response near complex poles and complex zeros.

46-min. Color Videotape
24-0108 Purchase $360 Rental $36.

THE FREQUENCY DOMAIN - Complete Set

Color Videotapes

Complete set of *eight* Color Videotapes.

24-1100 Purchase $2290 (SAVE $255)
40 Day Rental $238 (SAVE $18)

Suggested Text

Passive and Active Network Analysis and Synthesis by A. Budak, Houghton Mifflin, 1974, 733 pp.

24-3100 Purchase $17.95 each.

Study Guide

Comments, chalkboard photographs, reading assignments, problem solutions. 65 pp. (One per student recommended.)

24-2100 Purchase $4.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

The Operational Amplifier

Twelve Color Videotapes

The Ideal Operational Amplifier
Modeling of the ideal operational amplifier.

39-min. Color Videotape
24-0201 Purchase $325 Rental $33.

Linear Applications (1)
Analysis of inverting, non-inverting, difference, and other amplifier circuits.

41-min. Color Videotape
24-0202 Purchase $335 Rental $34.

Linear Applications (2)
Operational amplifier circuits for producing variable impedance, grounded current source, and bandpass filtering.

49-min. Color Videotape
24-0203 Purchase $370 Rental $37.

The One-Pole Rolloff Model
Discussion of the one-pole rolloff model.

39-min. Color Videotape
24-0204 Purchase $325 Rental $33.

Frequency Response
Frequency response of inverting and noninverting amplifiers. Demonstrations of the magnitude vs. frequency curves and the measurement of the gain-bandwidth product.

35-min. Color Videotape
24-0205 Purchase $305 Rental $31.

Bandwidth
Comparison of bandwidth for single and multistage amplifier circuits. Demonstration of extension of bandwidth with a capacitor.

34-min. Color Videotape
24-0206 Purchase $300 Rental $30.

Step Response
Relationship between pole position and rise time. Demonstration of ramp generator.

32-min. Color Videotape
24-0207 Purchase $285 Rental $29.

Output Impedance
Output equivalent circuit of amplifiers. Demonstration of the output impedance vs. frequency characteristic.

41-min. Color Videotape
24-0208 Purchase $335 Rental $34.

THE OPERATIONAL AMPLIFIER - Complete Set

Color Videotapes

Complete set of *twelve* Color Videotapes.

24-1200 Purchase $3395 (SAVE $465)
60 Day Rental $356 (SAVE $35)

Suggested Text

Passive and Active Network Analysis and Synthesis by A. Budak, Houghton Mifflin, 1974. 733 pp.

24-3100 Purchase $17.95 each.

Study Guide

Comments, chalkboard photographs, reading assignments, problem solutions. 100 pp. (One per student recommended.)

24-2200 Purchase $6.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Ideal and Actual Frequency Response
Bandwidth and rise-time improvement with negative capacitance. Demonstration of the effect of negative capacitance.

35-min. Color Videotape
24-0209 Purchase $305 Rental $31.

Offset, Slewing, and Dynamic Range
Discussion of limitations of integrated-circuit operational amplifiers. Demonstration of voltage-and current-limited response.

41-min. Color Videotape
24-0210 Purchase $335 Rental $34.

Nonlinear Applications (1)
Operational amplifier circuits using the nonlinear model of operation. Demonstration of the response of the dead-zone amplifier.

41-min. Color Videotape
24-0211 Purchase $335 Rental $34.

Nonlinear Applications (2)
Applications involving diodes and operational amplifier circuits. Demonstration of the characteristics of a fullwave rectifier circuit.

35-min. Color Videotape
24-0212 Purchase $305 Rental $31.

Nonlinear Vibrations

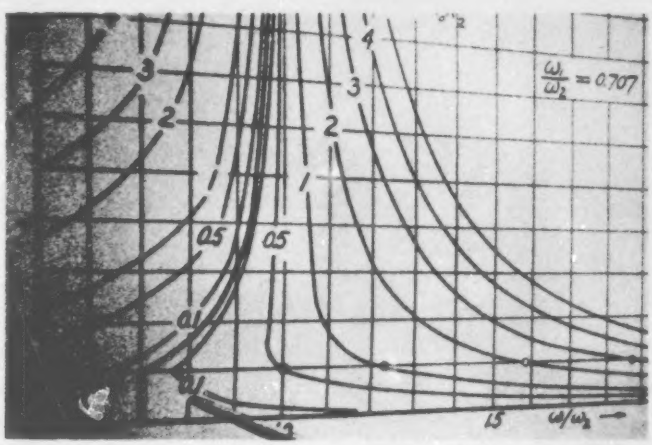
Jacob P. Den Hartog

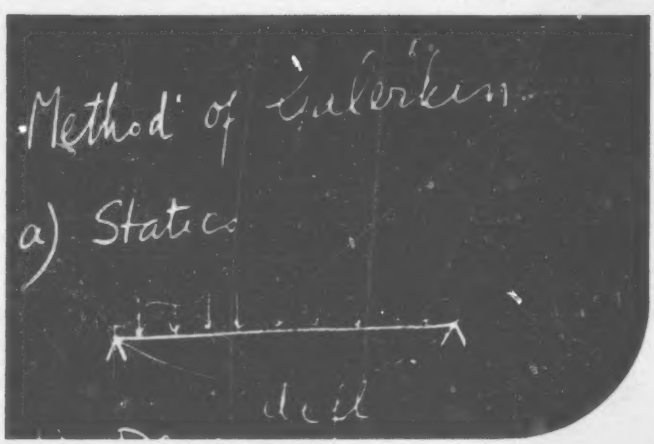
Nonlinear Vibrations describes various methods -- exact and approximate, numerical and graphical -- for dealing with vibrations in systems described by nonlinear differential equations. Although 95 per cent of vibrational problems can be analyzed with the aid of linear vibration theory, there is a baffling five per cent which clearly cannot.

A d-c motor driven by a d-c generator periodically reverses itself! A jet engine governor with a centrifugal pendulum vibrates to destruction. These and many other problems of great practical importance can only be understood in terms of nonlinear vibration theory.

It is the purpose of this series to use the simplest possible mathematics while keeping the physical interpretation of the mathematical model in sight with every step.

Jacob P. Den Hartog is Professor Emeritus of Mechanical Engineering at MIT.





Nonlinear Vibrations

Twenty-three B&W Videotapes

Introduction
Differences between linear and nonlinear vibrating systems... application of various differential equations...physical illustrations of some simple systtems...review of literature... description of the phase-plane method of solution.

36-min. B&W Videotape
16-0101 Purchase $235 Rental $24.

The Phase-Plane Method
Illustrated application of the phase-plane method to simple linear systems...undamped vibrator...negative spring... damped vibrator...negative damping...isoclinics... 'cannibal' asymptotes.

37-min. B&W Videotape
16-0102 Purchase $240 Rental $24.

Application of the Phase-Plane Method
Free vibration with Coulomb damping...simple pendulum with large angular motion...cylindrical phase plane.

30-min. B&W Videotape
16-0103 Purchase $205 Rental $21.

Pendulum in a Rotating Plane
Application of phase-plane method to a simple pendulum rotating about a vertical center line in a vertical plane...effect of centrifugal force on the oscillation.

32-min. B&W Videotape
16-0104 Purchase $215 Rental $22.

The Van der Pol Equation
Description of a self-excited system with damping dependent upon amplitude...reduction of the differential equation, by dimensional analysis, to its simplest form...comparison of the Van der Pol number to the Reynolds number.

31-min. B&W Videotape
16-0105 Purchase $210 Rental $21.

Relaxation Oscillations
Solutions of the Van der Pol Equation by general phase-plane method...determination of limit-amplitude by energy balance... case of large damping (large Van der Pol number)...approximate calculation of steady state frequency.

30-min. B&W Videotape
16-0106 Purchase $205 Rental $21.

Periodic Reversal of Rotation of a D.C. Motor
Presentation of a constant speed D.C. series generator driving a separately excited D.C. motor... explanation of periodic reversal of rotation of the D.C. motor on the basis of the Van der Pol Equation.

34-min. B&W Videotape
16-0107 Purchase $225 Rental $23.

Forced Undampled Vibrator with Nonlinear Spring
Solution by means of Martienssen's method... Martienssen's diagram...the 'jump phenomenon'...introduction of damping effects by energy balance...stable and unstable branches in the resonance diagram.

33-min. B&W Videotape
16-0108 Purchase $220 Rental $22.

Piece-Wise Linear Systems
Forced vibration of undamped vibrator with piece-wise linear springs by Martienseen's method ...systems with clearances and preset springs.

33-min. B&W Videotape
16-0109 Purchase $220 Rental $22.

Forced Vibrator with Nonlinear Damping
Replacement of nonlinear damping by 'equivalent' linear damping to equalize the work per cycle in each case...reduction to a linear case in which the 'equivalent linear damping constant' is dependent on frequency and amplitude.

31-min. B&W Videotape
16-0110 Purchase $210 Rental $21.

Exact Solutions, (1)
Undamped free vibration with nonlinear spring...forced undamped vibration with piece-wise linear spring...comparison of latter result with Martienseen's approximation in Lesson 9.

37-min. B&W Videotape
16-0111 Purchase $240 Rental $24.

Exact Solutions, (2)
Forced vibration with Coulomb damping...comparison of this exact solution with the approximation of Lesson 10.

35-min. B&W Videotape
16-0112 Purchase $230 Rental $23.

The Sommerfeld Effect
'Jump phenomenon' resulting from a highly damped rotor accelerated through its critical speed by the increase of voltage of the driving D.C. motor... idealization of the system and solution by energy balance.

32-min. B&W Videotape
16-0113 Purchase $215 Rental $22.

Tuned Centrifugal Pendulum
Frahm's Vibration Absorber as applied to torsional vibration in reciprocating engines... utilization of centrifugal force for required tuning following totational engine speed...(only lecture on linear systems).

34-min. B&W Videotape
16-0114 Purchase $225 Rental $23.

Nonlinear Centrifugal Pendulum
Jump phenomenon observed on aircraft piston engine...idealization to a simple system...deliberate de-tuning of pendulum for small angles in order to tune it for large angles of swing... system of two coupled differential equations, both highly nonlinear.

24 min. B&W Videotape
16-0115 Purchase $165 Rental $20.

NONLINEAR VIBRATIONS - Complete Set

Videotapes

Complete set of *twenty-three* B&W videotapes

16-1100 Purchase $4315 (SAVE $645)
115 Day Rental $455 (SAVE 53)

Suggested Text

Mechanical Vibrations, (Fourth Edition) by J.P. Den Hartog, McGraw-Hill, 436 pp.

16-3100 Purchase $16.50 each.

Study Guide

Comments, photographs, reading assignments, problems, and problem solutions. 244 pp. (One per student recommended.)

16-2100 Purchase $10.50 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Solution and Interpretation
Solution of the preceding equations by a modified Martienssen method giving a diagram from which the jump phenomenon can be seen immediately...calculation of the critical angle showing the impossibility of engine operation with pendulum swing above 30 degrees.

33-min. B&W Videotape
16-0116 Purchase $220 Rental $22.

Aircraft Jet Rotor with Ball Bearings with Clearances
Reduction of system to a simple model...illustration of jump phenomenon by another modification of Martienssen's method... avoidance of large amplitude resonances by proper detail dimensioning.

32-min. B&W Videotape
16-0117 Purchase $215 Rental $22.

Method of Krylov-Bogoliubov
Presentation of systems with small and moderate nonlinearities in the damping or the spring...derivation of the (approximate) result in the standard manner.

24-min. B&W Videotape
16-0118 Purchase $165 Rental $20.

Physical Interpretation of the K & B Formulas
Interpretation on the basis of energy balance and Fourier analysis of the nonlinear force...fundamental force harmonic in phase with motion interpreted as a spring; cross-phase component furnishing dashpot effect.

29-min. B&W Videotape
16-0119 Purchase $195 Rental $20.

Method of Galerkin
Originally proposed for static systems...later applied to dynamics and particularly to slightly non-linear vibrations ...all previously discussed approximate methods shown to be special cases of Galerkin.

34-min. B&W Videotape
16-0120 Purchase $225 Rental $23.

Applications
Treatment of the cubic spring and the large swing pendulum by the four approximate methods... comparison of the approximate methods with the exact (phase-plane) procedure, proving the K & B approximation to be the best of the four.

34-min. B&W Videotape
16-0121 Purchase $225 Rental $23.

Modified Martienssen Method-Subharmonic Resonance
Variation of the simple Martienssen method adapting it to the greater accuracy obtainable by the K & B or 'harmonic balance' method...physical discussion of subharmonic resonance.

32-min. B&W Videotape
16-0122 Purchase $215 Rental $22.

Volterra's Fishes
Biological problem of population fluctuation of two species of fish dependent upon one another ...dimensionless treatment of the equations...graphical solution and physical interpretation.

37-min. B&W Videotape
16-0123 Purchase $240 Rental $24.

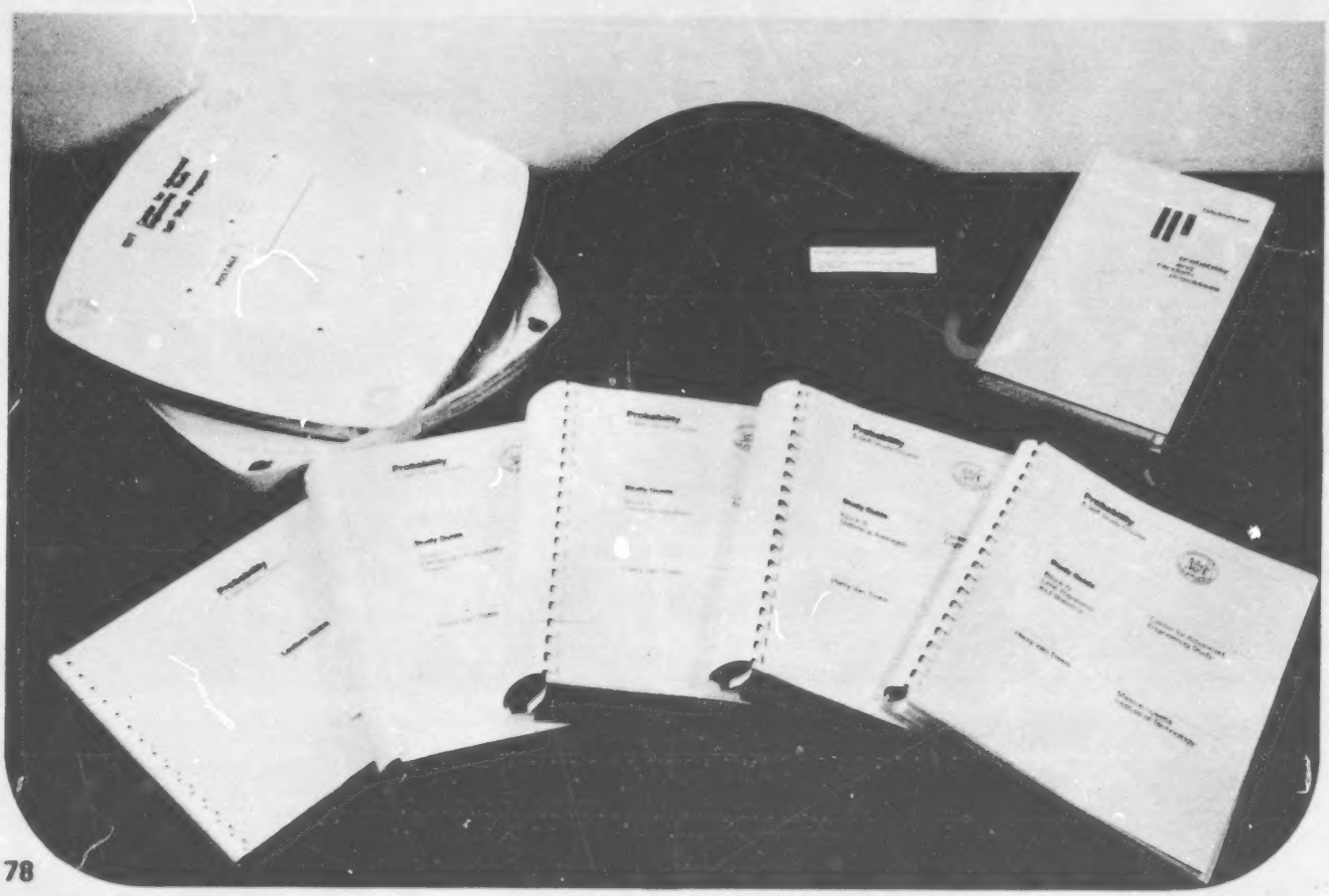
Probability and Random Processes

Harry L. Van Trees

Probability is a post-calculus approach to this important mathematical discipline. Even a cursory survey of engineering, for example, reveals the widespread applicability of probability theory. Such diverse fields as systems analysis, decision theory, statistics, automatic control, modern management, and cybernetics all rely on a probabilistic approach.

Random Processes is a follow-on to Probability and a prerequisite to study in such areas as advanced communications and queuing theory. Included are discussions of three completely characterized processes - the Poisson, Markov, and Gaussian processes.

Harry L. Van Trees is Professor of Electrical Engineering at MIT.



Probability

Elementary Probability Theory

Thirteen B&W 16mm Films or Videotapes

Introduction to Probability
This lecture presents a few examples of cases where probability theory is applied. It discusses the subject of relative frequency and its relationship to the idea of probability. Physical systems and mathematical models.

35-min. B&W Film or Videotape
12-0101 Purchase $230 Rental $23.

Formulation of Mathematical Models (1)
Formulation of mathematical models in probability theory. Deals with the definition of a probabilistic experiment and with the definition of an event. Three examples involving the tossing of a coin or of dice. Representation of events on lines or in two-dimensional space.

22-min. B&W Film or Videotape
12-0102 Purchase $150 Rental $20.

Formulation of Mathematical Models (2)
Continues discussion of formulation of mathematical models. Events are defined as a collection of sample points. The idea of an event in continuous sample space is illustrated.

30-min B&W Film or Videotape
12-0103 Purchase $205 Rental $21.

Elementary Set Theory
Introduces basic ideas of elementary set theory. Defines and illustrates graphically the ideas of equality, inclusion, union, intersection, complementarity, difference, null-sets, disjoint sets, and partitioning.

29-min. B&W Film or Videotape
12-0104 Purchase $195 Rental $20.

Theorem Proving
Introductory lecture on theorem proving. Proof of an "IF and only IF" type of theorem. Proof by contradiction.

18-min. B&W Film or Videotape
12-0105 Purchase $125 Rental $20.

Probabilistic Models
Covers the five basic axioms of probability theory. Illustrates those axioms through a number of examples. Shows that, once probability assignments have been made which are consistant with the five axioms, the probabilistic model of an experiment is always a legitimate one.

45-min. B&W Film or Videotape
12-0106 Purchase $285 Rental $29.

Proof by Induction
Continuation of theorem proving. Illustrates in detail proof by induction. Presents an example involving the two basic steps of typical proof by induction.

16-min. B&W Film or Videotape
12-0107 Purchase $115 Rental $20.

Joint Probability
Idea of joint probability is introduced through the use of two examples. Shows that joint probabilities must obey the axioms of probability theory.

19-min. B&W Film or Videotape
12-0108 Purchase $130 Rental $20.

Conditional Probability (1)
First of two lectures on conditional probability. Illustrates how probabilities change when events are conditioned by other events. Definition of conditional probability.

18-min. B&W Film or Videotape
12-0109 Purchase $125 Rental $20.

Conditional Probability (2)
Continuation of the previous lecture on conditional probability. The lecture goes through a detailed example on reliability to illustrate the ideas of conditional probability. Bayes rule is derived.

26-min. B&W Film or Videotape
12-0110 Purchase $175 Rental $20.

Conditional Probability: A Digital Communications Example
Conditional probability is illustrated through a digital comunications example. Construction of sample space from conditional probability assumptions or measurements. Application of probabilistic ideas to the design of the system.

29-min. B&W Film or Videotape
12-0111 Purchase $195 Rental $20.

Statistical Independence
The fundamental concept of statistical independence is defined and its meaning is illustrated through a number of examples. The utility of this concept in probabilistic analysis is discussed briefly.

19-min. B&W Film or Videotape
12-0112 Purchase $130 Rental $20.

Product Spaces & Statistically Independent Experiments
Extends the concept of statistical independence. Construction of product spaces from statistically independent experimental outcomes. Successive coin tosses.

17-min. B&W Film or Videotape
12-0113 Purchase $120 Rental $20.

Random Variables

Sixteen B&W 16mm Films or Videotapes

Random Variables (1)
Introduction to random variables. Probability distributions and probability distribution functions are defined. Properties of probability distribution functions.

26-min. B&W Film or Videotape
12-0201 Purchase $175 Rental $20.

Random Variables (2)
Continuous random variables. Probability density functions and their properties. Example of a uniform random variable.

20-min. B&W Film or Videotape
12-0202 Purchase $140 Rental $20.

ELEMENTARY PROBABILITY THEORY - Complete Set

Films/Videotapes

Complete set of *thirteen* B&W 16 mm films or videotapes.

12-1100 Purchase $1960 (SAVE $220)
65 Day Rental $254 (SAVE $19)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

12-3100 Purchase $19.50 each.

Lecture Notes

Chalkboard photographs of all the films/videotapes of Probability.

12-4100 Purchase $4.50 each.

Study Guide

Introduction to the topics, summarization of key concepts, problems, and problem solutions. 374 pp. (One per student recommended.)

12-2100 Purchase $12.00 each. (10% Discount on five or more.)

Pretest

Mathematics pretest to determine proficiency in calculus concepts and techniques used in Probability. 74 pp.

12-5100 Purchase $2.50 each.

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes and Suggested Text.

Canonical Random Variables
Describes the standard variables often used in practice. Exponential random variable is introduced and illustrated.

11-min. B&W Film or Videotape
12-0203 Purchase $80 Rental $20.

Mixed Random Variables
Random variables are classified as continuous, discrete or mixed. The definition of an impulse is provided. Detailed example illustrates mixed random variables.

30-min. B&W Film or Videotape
12-0204 Purchase $205 Rental $21.

Conditioning
The conditioning of random variables is defined. It is shown that conditional random variables have all the properties of ordinary random variables.

15-min. B&W Film or Videotape
12-0205 Purchase $115 Rental $20.

Multiple Random Variables: Discrete
Definition of joint probability distribution functions. Definition of marginal probability distribution functions. Discussion of the properties of both
A detailed example is presented.

34-min. B&W Film or Videotape
12-0206 Purchase $225 Rental $23.

Continous Random Variables
Joint probability distribution functions for continuous random variables. Joint probability density functions, marginal distribution functions, and marginal density functions for continuous random variables. Properties and examples.

34-min. B&W Film or Videotape
12-0207 Purchase $225 Rental $23.

Impulsive Densities
Densities containing impulses are discussed. Integration and differentiation for these densities are illustrated.

18-min. B&W Film or Videotape
12-0208 Purchase $125 Rental $20.

Statistically-Independent Random Variables
Statistical independence is defined in terms of probability distribution functions. The concept is illustrated with the derivation of a marginal density function. The idea of utility is introduced.

25-min. B&W Film or Videotape
12-0209 Purchase $170 Rental $20.

Conditioning by Sets
The conditioning of probability distributions and probability densities on sets is illustrated. Conditional distribution functions are defined.

16-min. B&W Film or Videotape
12-0210 Purchase $110 Rental $20.

Point Conditioning
Conditioning is extended to point-conditioning. This leads to the definition of conditional distribution functions of random variables.

17-min. B&W Film or Videotape
12-0211 Purchase $120 Rental $20.

A Digital Communication Application
A detailed example of a communication system with noise added is presented. Model of the communication system and the idea of minimum error decision. Computation of error probabilities.

49-min. B&W Film or Videotape
12-0212 Purchase $310 Rental $31.

Functions of a Random Variable
Computation of probability distributions for functions of a single random variable. Standard procedure for this computation. Illustration through example.

22-min. B&W Film or Videotape
12-0213 Purchase $150 Rental $20.

Functions of Vector Random Variables (1)
Computation of probability distributions for functions of vectors of random variables. Standard procedure. Special case of statistically independent random variables.

19-min. B&W Film or Videotape
12-0214 Purchase $130 Rental $20.

Reliability Applications
Introduction to the computation of reliability. Standard configurations of networks. Components in series and in parallel.

30-min. B&W Film or Videotape
12-0215 Purchase $205 Rental $21.

Function of Vector Random Variables (2)
More complicated derivations of probability distributions for functions of vectors of random variables. Illustration through example.

11-min. B&W Film or Videotape
12-0216 Purchase $80 Rental $20.

Statistical Averages

Eleven B&W 16mm Films or Videotapes

Statistical Averages: Expectation of a Random Variable
The fundamental concept of expectation is introduced. Computation of expected values for continuous and discrete random variables.

19-min. B&W Film or Videotape
12-0301 Purchase $130 Rental $20.

Expectations of Functions of a Random Variable
The concept of expectation is extended to functions of random variables. It is shown that expectation is a linear operator. Examples are presented.

23-min. B&W Film or Videotape
12-0302 Purchase $160 Rental $20.

Moments of a Random Variable
Moments and central moments are defined. Variance and standard deviation. Properties of variance and examples.

18-min. B&W Film or Videotape
12-0303 Purchase $125 Rental $20.

RANDOM VARIABLES - Complete Set

Films/Videotapes

Complete set of *sixteen* B&W 16 mm films or videotapes.

12-1200 Purchase $2310 (SAVE $255)
80 Day Rental $308 (SAVE $31)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

12-3100 Purchase $19.50 each.

Lecture Notes

Chalkboard photographs of all the films/videotapes of Probability.

12-4100 Purchase $4.50 each.

Study Guide

Introduction to the topics, summarization of key concepts, problems, and problem solutions. 542 pp. (One per student recommended.)

12-2200 Purchase $17.50 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes and Suggested Text.

The Chebyshev Inequality
The Chebyshev inequality is derived and explained. The lecture also includes a discussion of how good a Chebyshev inequality is as a bound on probabilities.

29-min. B&W Film or Videotape
12-0304 Purchase $195 Rental $20.

Estimation of Random Variables
Deals with the choice of estimators for random variables. The mean-square error is discussed as a criterion for estimation. Two examples illustrate the concept.

23-min. B&W Film or Videotape
12-0305 Purchase $160 Rental $20.

Conditional Expectation
The idea of conditional expectation is introduced. Conditional expectation on a joint Gaussian probability density. Importance of the concept in estimation.

13-min. B&W Film or Videotape
12-0306 Purchase $95 Rental $20.

Minimum Mean-Square Error Estimation
Reviews the idea of the minimum mean-square error estimator. An example involving the joint Gaussian probability density is presented.

18-min. B&W Film or Videotape
12-0307 Purchase $125 Rental $20.

Joint Moments: Correlation
Joint moments of random variables are defined. Correlation, covariance and the correlation coefficients. Basic properties of joint moments. Predictive value.

27-min. B&W Film or Videotape
12-0308 Purchase $180 Rental $20.

Linear Estimation
Linear estimation is introduced. Fundamental expressions are derived. Minimum mean-square estimators are discussed in this light.

44-min. B&W Film or Videotape
12-0309 Purchase $280 Rental $28.

Characteristic Functions
Characteristic functions are defined. The four fundamental properties of characteristic functions are derived.

25-min. B&W Film or Videotape
12-0310 Purchase $170 Rental $20.

Joint Characteristic Functions
The concept of a characteristic function is extended to vectors of random variables. Properties of joint characteristic functions are derived and discussed.

25-min. B&W Film or Videotape
12-0311 Purchase $170 Rental $20.

STATISTICAL AVERAGES - Complete Set

Films/Videotapes

Complete set of *eleven* B&W 16 mm films or videotapes.

12-1300 Purchase $1645 (SAVE $145)
55 Day Rental $212 (SAVE $16)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

12-3100 Purchase $19.50 each.

Lecture Notes

Chalkboard photographs of all the films/videotapes of Probability.

12-4100 Purchase $4.50 each.

Study Guide

Introduction to the topics, summarization of key concepts, problems, and problem solutions. 406 pp. (One per student recommended.)

12-2300 Purchase $13.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes and Suggested Text.

Limit Theorems and Statistics

Nine B&W 16mm Films or Videotapes.

Sample Means and the Weak Law of Large Numbers
The sample mean is presented as an estimator of expectation. The weak law of large numbers. Convergence in the mean-square sense. Discussion of different types of convergence.

30-min. B&W Film or Videotape
12-0401 Purchase $205 Rental $21.

Relative Frequency
Relative frequency is defined. Shows that the relative frequency of an event converges to the probability of that event. An example is presented.

18-min. B&W Film or Videotape
12-0402 Purchase $125 Rental $20.

The Gaussian Approximation
Introduces the idea of using the Gaussian approximation for large samples. An example using binomial distribution is discussed in detail. Comparison between exact estimates and the Gaussian approximation.

33-min. B&W Film or Videotape
12-0403 Purchase $220 Rental $22.

Central Limit Theorem
The derivation of the central limit theorem is outlined. Its implications are discussed in detail. Illustration approximations through the central limit theorem.

35-min. B&W Film or Videotape
12-0404 Purchase $230 Rental $23.

Introduction to Statistical Inference
The idea of statistical inference is introduced. Estimation of a probability density, estimation of moments, hypothesis testing, testing with unspecifed alternatives. The meaning of statistics.

18-min. B&W Film or Videotape
12-0405 Purchase $125 Rental $20.

Estimation of the Moments of a Random Variable
Estimation of moments. Unbiased estimators. Consistant estimators. Normalized variance. Illustration through the use of two statistical problems.

37-min. B&W Film or Videotape
12-0406 Purchase $240 Rental $24.

LIMIT THEOREMS AND STATISTICS - Complete Set

Films/Videotapes

Complete set of *nine* B&W 16 mm films or videotapes.

12-1400 Purchase $1610 (SAVE $140)
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Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

12-3100 Purchase $19.50 each.

Lecture Notes

Chalkboard photographs of all the films/videotapes of Probability.

12-4100 Purchase $4.50 each.

Study Guide

Introduction to the topics, summarization of key concepts, problems, and problem solutions. 254 pp. (One per student recommended.)

12-2400 Purchase $8.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of films/videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide, Lecture Notes and Suggested Text.

Estimation of the Parameter of a Probability Density
Procedure and issues in the estimation of parameters of probability densities. Likelihood functions. Maximum likelihood estimators. Biases.

27-min. B&W Film or Videotape
12-0407 Purchase $180 Rental $20.

Performance Bounds: The Cramer-Rao Inequality
The Cramer-Rao inequality as a lower bound on the variance of unbiased estimators. Efficient estimators. Comments on the use of efficient estimators.

28-min. B&W Film or Videotape
12-0408 Purchase $190 Rental $20.

Estimation of the Probability Density of a Random Variable
Detailed example on the estimation of a probability density function. Pitfalls and procedures for the estimation of probability densities. Use of variance analysis.

36-min. B&W Film or Videotape
12-0409 Purchase $235 Rental $24.

Random Processes

Introduction

Seven B&W Videotapes

Introduction to Random Processes
Introduces, through the use of examples, the analytical approaches by which random process theory may be applied to a variety of physical problems.

33-min. B&W Videotape
13-0101 Purchase $220 Rental $22.

Random Processes: Basic Concepts and Definitions
Extends the usual sample-space definition of random variables to the case of random processes, and thereby introduces the notion of a complete characterization.

28-min. B&W Videotape
13-0102 Purchase $190 Rental $20.

Fixed-Form Random Processes
Discusses the simple case of fixed-form processes, wherein a small number of random variables completely characterize the process.

25-min. B&W Videotape
13-0103 Purchase $170 Rental $20.

Binary Transmission Wave
Treats the binary transmission wave and introduces stationarity concepts.

32-min. B&W Videotape
13-0104 Purchase $215 Rental $22.

Random Telegraph Wave
Considers the random telegraph wave and uses that example to introduce the minimum mean-square error (MMSE) prediction problem.

24-min. B&W Videotape
13-0105 Purchase $165 Rental $20.

Second-Moment Characterizations
Relaxes the constraint of complete characterization by introducing the concept of partial characterization by the mean function and correlation function.

38-min. B&W Videotape
13-0106 Purchase $250 Rental $25.

The Role of the Covariance Function in Estimation
Returns to the MMSE prediction problem for the case in which the predictor is constrained to be linear.

22-min. B&W Videotape
13-0107 Purchase $150 Rental $20.

INTRODUCTION TO RANDOM PROCESSES - Complete Set

Videotapes

Complete set of *seven* B&W videotapes.

13-1100 Purchase $1250 (SAVE $110)
35 Day Rental $139 (SAVE $10)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

12-3100 Purchase $19.50 each.

Study Guide

A step-by-step path through the subject with photographs, problem sets, quiz, and solutions. 164 pp. (One per student recommended.)

13-2100 Purchase $5.50 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Linear Systems

Twelve B&W Videotapes

System Descriptions
Introduces the basic concept of a single-input single-output system, and presents a number of examples and special cases including the important class of linear systems.

22-min. B&W Videotape
13-0201 Purchase $150 Rental $20.

Linear System Descriptions
Discusses the characterization of a linear time-invariant (LTI) system in the time domain by its impulse response.

40-min. B&W Videotape
13-0202 Purchase $260 Rental $26.

Measurement of Inpulse Response
Demonstration of the relative invariance of linear time-invariant system responses to the detailed shape of a pulse input of short duration but fixed area.

11-min. B&W Videotape
13-0203 Purchase $80 Rental $20.

Convolution Integral
Provides calculational exercises with convolution integrals, i.e. the time domain input-output equation for an LTI sytem.

16-min. B&W Videotape
13-0204 Purchase $115 Rental $20.

System Classification
Provides a further investigation of the classification of systems according to their input-output properties.

27-min. B&W Videotape
13-0205 Purchase $130 Rental $20.

Complex Exponential Inputs: Frequency Domain Analysis
Begins the frequency domain analysis of LTI systems by considering the response of such systems to complex exponential excitations.

28-min. B&W Videotape
13-0206 Purchase $190 Rental $20.

Periodic Inputs and Fourier Series
Continues the frequency domain analysis of LTI systems by developing the Fourier series representation for periodic signals and considering the response of such systems to periodic inputs.

28-min. B&W Videotape
13-0207 Purchase $190 Rental $20.

Fourier Series Demonstration
Approximation representation of a square wave by a sum of sine and cosine waves - even and odd functions, even and odd harmonics, Gibb's phonomenon, mean square error property.

15-min. B&W Videotape
13-0208 Purchase $115 Rental $20.

LINEAR SYSTEMS - Complete Set

Videotapes

Complete set of *twelve* B&W videotapes.

13-1200 Purchase $1970 (SAVE $220)
60 Day Rental $240 (SAVE $18)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

12-3100 Purchase $19.50 each.

Study Guide

A step-by step path through the subject with photographs, problem sets, quiz, and solutions. 282 pp. (One per student recommended.)

13-2200 Purchase $9.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Fourier Transforms
Makes the transition from the Fourier series to the Fourier transform representation for aperiodic signals, and derives the convolution - multiplication theorem that relates the time and frequency domain representations of LTI system input-output pairs.

33-min. B&W Videotape
13-0209 Purchase $220 Rental $22.

System Functions
Describes some techniques for measuring system functions (impulse response and frequency response), and also considers the analysis of linear systems characterized by differential equations or the cascade of several linear systems.

35-min. B&W Videotape
13-0210 Purchase $230 Rental $23.

Fourier Transform Properties
Treats the mathematical properties of the Fourier transform.

42-min. B&W Videotape
13-0211 Purchase $270 Rental $27.

Sampling Theorem
Discusses the representation of a bandlimited waveform by its time samples.

28-min. B&W Videotape
13-0212 Purchase $190 Rental $20.

Second Moment Theory

Eight B&W Videotapes

Linear Systems with Random Process Inputs
Begins the study of linear filtering of random processes by deriving the mean function and correlation function of the output of a linear system driven by noise.

31-min. B&W Videotape
13-0301 Purchase $210 Rental $21.

Time Averages
Builds upon the results of the previous lecture to investigate the relationship between statistical (ensemble) averages and empirical (time) averages of random processes.

45-min. B&W Videotape
13-0302 Purchase $285 Rental $29.

Frequency Domain Analysis of Stationary Random Processes
Develops the basic frequency - domain analysis of wide-sense stationary random processes.

36-min. B&W Videotape
13-0303 Purchase $235 Rental $24.

White Noise
Devoted to the definition and use of white-noise processes in linear-system calculations.

17-min. B&W Videotape
13-0304 Purchase $120 Rental $20.

SECOND MOMENT THEORY - Complete Set

Videotapes

Complete set of *eight* B&W videotapes.

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40 Day Rental $181 (SAVE $10)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

12-3100 Purchase $19.50 each.

Study Guide

A step-by step path through the subject with photographs, problem sets, quiz, and solutions. 230 pp. (One per student recommended.)

13-2300 Purchase $7.50 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Two Applications of White Noise
Discusses two applications of white noise: synthesis of a random process with a desired spectrum, and measurement of linear-system impulse response.

18-min. B&W Videotape
13-0305 Purchase $125 Rental $20.

Matched Filters
Derives the matched-filter as the optimum linear processor for detection of a known signal in additive white noise.

41-min. B&W Videotape
13-0306 Purchase $265 Rental $27.

Optimum Fixed Form Linear Filters
Continues the discussion of linear signal processing by considering optimum fixed-form filters for estimating a random signal embedded in additive noise.

34-min. B&W Videotape
13-0307 Purchase $225 Rental $23.

Optimum Linear Filters
Concludes the discussion of linear signal processing by deriving the optimum unrealizable filter for estimating a random singal embedded in additive noise.

41-min. B&W Videotape
13-0308 Purchase $265 Rental $27.

Poisson Processes

Five B&W Videotapes

Introduction to Poisson Processes
Introduces the Poisson counting process through its independent increments property and mentions its potential application areas.

29-min. B&W Videotape
13-0401 Purchase $195 Rental $20.

Poisson Counting Processes
Reviews the definition of the Poisson counting process and calculates the counting probabilities from its incremental statistics.

40-min. B&W Videotape
13-0402 Purchase $260 Rental $26.

Arrival Times
Derives the arrival-time statistics for the Poisson counting process.

14-min. B&W Videotape
13-0403 Purchase $100 Rental $20.

Filtered Poisson Process
Builds upon previous results to study the statistics of a linearly filtered Poisson impulse train i.e. a shot-noise process.

30-min. B&W Videotape
13-0404 Purchase $205 Rental $21.

POISSON PROCESSES - Complete Set

Videotapes

Complete set of *five* B&W videotapes.

13-1400 Purchase $815 (SAVE $70)
25 Day Rental $97 (SAVE $10)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

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Study Guide

A step-by-step path through the subject with photographs, problem sets, quiz, and solutions. 118 pp. (One per student recommended.)

13-2400 Purchase $4.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Limiting Behavior of Filtered Poisson Processes
Continues the development of shot-noise statistics by demonstrating the approach of high-density shot-noise to a Gaussian distribution.

18-min. B&W Videotape
13-0405 Purchase $125 Rental $20.

Markov Processes

Six B&W Videotapes

Introduction to Markov Processes
Begins the study of discrete-state continuous-time Markov processes by use of examples, and introduces the state transition diagram.

32-min. B&W Videotape
13-0501 Purchase $215 Rental $22.

Markov Process Equations
Considers the basic analysis techniques for finding the transient and equilibrium statistics of a discrete-state continuous-time Markov process.

47-min. B&W Videotape
13-0502 Purchase $300 Rental $30.

Finite-State Processes
Discusses explicit solution techniques for the transient and equilibrium behavior of finite state Markov processes.

29-min. B&W Videotape
13-0503 Purchase $195 Rental $20.

Pure Birth Process
Obtains the state-occupation probabilities for a pure-birth process.

16-min. B&W Videotape
13-0504 Purchase $115 Rental $20.

Linear Birth Processes
Continues the discussion of the previous lecture for the case of linear birth processes.

25-min. B&W Videotape
13-0505 Purchase $170 Rental $20.

Equilibrium Distributions: Infinite State Processes
Investigates the existence of and solution for the equilibrium distribution in an infinite-state Markov process.

16-min. B&W Videotape
13-0506 Purchase $115 Rental $20.

MARKOV PROCESSES - Complete Set

Videotapes

Complete set of *six* B&W videotapes.

13-1500 Purchase $1020 (SAVE $90)
30 Day Rental $122 (SAVE $10)

Study Guide

A step-by-step path through the subject with photographs, problem sets, quiz, and solutions. 156 pp. (One per student recommended.)

13-2500 Purchase $5.00 each. (10% Discount on five or more.)

A Complete Self-Study Subject.
The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide .

Gaussian Processes

Seven B&W Videotapes

Introduction to Gaussian Random Processes
Introduces the Gaussian process through examples that make use of the central limit theorem.

15-min. B&W Videotape
13-0601 Purchase $115 Rental $20.

Gaussian Random Vectors
Develops the properties of Gaussian random vectors including joint probability density, and characteristic functions.

34-min. B&W Videotape
13-0602 Purchase $225 Rental $23.

Gaussian Random Processes
Defines the Gaussian random process in terms of Gaussian random vectors and uses the definition to show that the mean and covariance function completly characterize the Gaussian process.

17-min. B&W Videotape
13-0603 Purchase $120 Rental $20.

Gaussian Processes and Linear Systems
Combines the results of the previous lecture with those of second moment theory to completely characterize the output of a linear system driven by Gaussian noise.

11-min. B&W Videotape
13-0604 Purchase $80 Rental $20.

Gaussian Processes and Nonlinear Systems
Uses the moment factoring property of Gaussian random variables to investigate the response of non-linear systems to Gaussian noise.

17-min. B&W Videotape
13-0605 Purchase $120 Rental $20.

Linear Optimality and General Optimality
Uses the results of previous lectures in conjunction with the optimum linear filtering results of second moment theory to show that linear optimality is identical to global optimality for Gaussian processes

31-min. B&W Videotape
13-0606 Purchase $210 Rental $21.

Summary of Gausian Processes
Concludes the study of Gaussian processes by summarizing the key properties derived in the previous lectures.

10-min. B&W Videotape
13-0607 Purchase $75 Rental $20.

GAUSSIAN PROCESSES - Complete Set

Videotapes

Complete set of *seven B&W* videotapes.

13-1600 Purchase $870 (SAVE $75)
30 Day Rental $134 (SAVE $10)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970, 542 pp.

12-3100 Purchase $19.50 each.

Study Guide

A step-by-step path through the subject with photographs, problem sets, quiz, and solutions. 180 pp. (One per student recommended.)

13-2600 Purchase $6.00 each (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

Measurement of Process Characteristics

Three B&W Videotapes

Measurement of Random Process Characteristics
Introduces the goals of and problems encountered in measuring the statistics of a random process from sample-function observations.

32-min. B&W Videotape
13-0701 Purchase $215 Rental $22.

Measurement of Mean-Square Value of a Random Process
Evaluates the bias and variance of the time-average estimate of the mean-square value of a Gaussian random process.

41-min. B&W Videotape
13-0702 Purchase $265 Rental $27.

Measurement of Power Density Spectra
Provides an introduction to spectral density estimation and develops an appreciation for the tradeoff between resolution and accuracy.

25-min. B&W Videotape
13-0703 Purchase $170 Rental $20.

MEASUREMENT OF PROCESS CHARACTERISTICS - Complete Set

Videotapes

Complete set of *three* B&W videotapes.

13-1700 Purchase $600 (SAVE $50)
15 Day Rental $59 (SAVE $10)

Suggested Text

Probability and Random Processes, W.B. Davenport, Jr., McGraw Hill, 1970 542 pp.

12-3100 Purchase $19.50 each.

Study Guide

A step-by-step path through the subject with photographs, problem sets, quiz, and solutions. solutions. 58 pp. (One per student recommended.)

13-2700 Purchase $4.00 each (10% Discount on five or more.)

A Complete Self-Study Subject. The set of videotapes described above can be used as a complete self-study subject when accompanied by the Study Guide and Suggested Text.

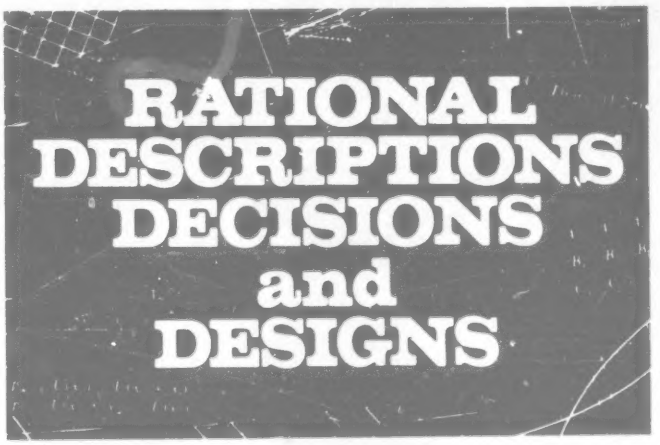
Thermostatics and Thermodynamics

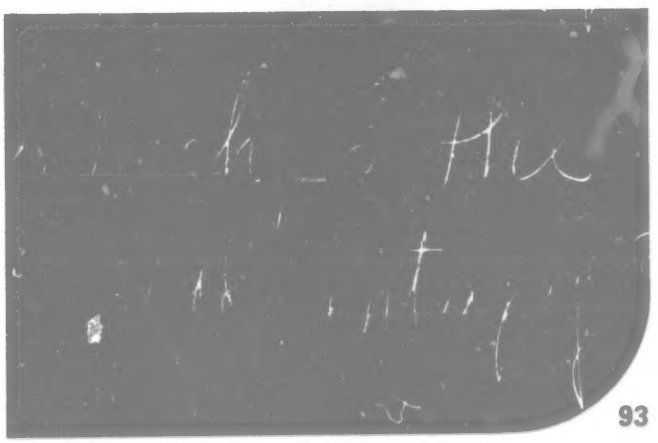
Myron Tribus

Thermostatics and Thermodynamics - An Information Theory Approach asks whether there is more than an analogy between thermodynamic entropy and communication entropy. What is the connection between statistical mechanics and thermodynamics? This series of ten lectures develops probability theory and entropy from an information theoretic basis. The results are applied to a variety of problems to build up the concepts of statistical inference needed to establish statistical mechanics and thermodynamics.

These color videotapes were recorded in a television studio before a small group of practicing engineers. The series was produced in Rochester, New York, under a grant from the Xerox Corporation.

Myron Tribus was Senior Vice President, Xerox Corporation, and is now Professor of Engineering and Director, Center for Advanced Engineering Study, MIT.





Thermostatics and Thermodynamics

Ten Color Videotapes

Entropy in Thermodynamics and Communication
Constrasts inductive and deductive logic. Gives desiderata for the design of an inductive logic system. Introduces the use of Boolean symbols.

50-min. Color Videotape
29-0101 Purchase $375 Rental $38.

Logical Basis for Probability
Conditional probability, scaling rules, functional constraints, the logic of denial statements, allowable transformations of probability.

49-min. Color Videotape
29-0102 Purchase $370 Rental $37.

A System of Inductive Logic
Review of consequences of desiderata for a system of logic. Probability as an "encoding" of knowledge. How to combine Boolean and ordinary algebraic operations. Historic interpretations of probability; Bayes equation and common sense.

50-min. Color Videotape
29-0103 Purchase $375 Rental $38.

Applying Bayes Equation
Bayes Equation applied to cancer detection. Calibration vs use of equipment. A method to "extend the conversation." Using the evidence transformation and other transformations.

50-min. Color Videotape
29-0104 Purchase $375 Rental $38.

Hypothesis Testing and Sequential Testing
Probability function applied to Bernoulli trials. The relation between probability and frequency. The evidence form of probability applied to hypothesis testing and sequential testing in quality control.

49-min. Color Videotape
29-0105 Purchase $370 Rental $37.

Hypothesis Testing
Bayes Equation. The cancer problem: should a biopsy be performed? Hypothesis testing. The test of a random number generator, the Chi Square Entropy as a measure of uncertainty.

49-min. Color Videotape
29-0106 Purchase $370 Rental $37.

Entropy
Entropy as a measure of ignorance. The maximum entropy principle. An application: predicting order size from order data. The Gibbs-Jaynes formalism of statistical inference.

51-min. Color Videotape
29-0107 Purchase $375 Rental $38.

The Thermodynamics of a Mythical Economy
Thermodynamics of Upper and Lower Slobovia (the "Thermodynamics" of a mythical economy). The laws of thermodynamics for a non-physical system. The exponential distribution and an analog of temperature. The concept of negative temperature. The grand canonical distribution for an artificial economy.

53-min. Color Videotape
29-0108 Purchase $380 Rental $38.

Statistical Thermodynamics
Statistical Mechanics. The Boltzmann distribution. The grand canonical distribution. The third law. The minimum postulates required for thermophysics. The relation between macroscopic concepts of work, path, heat, reversibility, etc. and statistical parameters.

55-min. Color Videotape
29-0109 Purchase $385 Rental $39.

Classical Thermodynamics
Statistical and classical thermodynamics compared. The basis for irreversibility in statistical phenomena, the domain of applicability of thermostatics. The role of diffusion in entropy generation. Why does thermodynamics work? Review of the 10 lectures.

53-min. Color Videotape
29-0110 Purchase $380 Rental $38.

THERMODYNAMICS - Complete Set

Color Videotapes

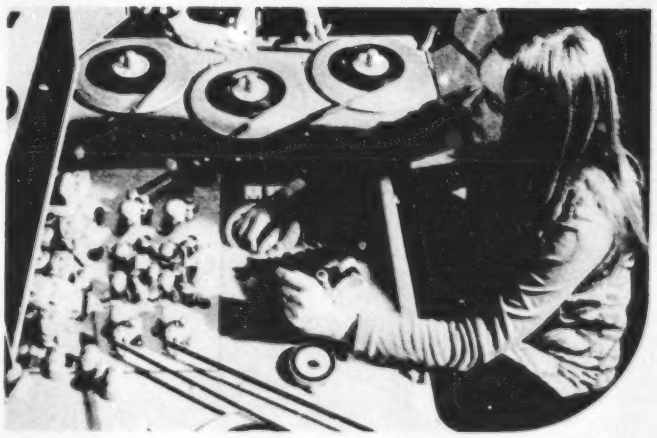
Complete set of *ten* Color Videotapes

29-1100 Purchase $3305 (SAVE $450)
50 Day Rental $344 (SAVE $34)

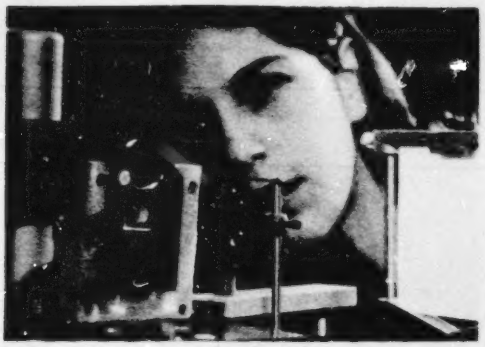
Special Programs

Among the many lectures and demonstrations listed earlier in this catalog are a few that bear special mention. The purpose of this section is to single these out as well as to introduce a few one-of-a-kind programs produced by MIT. Thus, in the pages that follow, you will find listed once again such outstanding demonstrations as "Recursion" as well as such unusual productions - listed for the first time - as "Women's Work: Engineering."

In addition, you will find a special series on "The Management of Technological Innovation" recorded in color in December 1975. Most of the other lectures and demonstrations were recorded in the CAES color studio; the two "Women's Work" documentaries, however, were filmed on location.



Special Programs



Women's Work: Engineering
A documentary film designed to motivate young women to consider careers in engineering. Shows women engineering students and professional engineers in school, on the job and at leisure. Also confronts the problem of combining a career with the responsibilities of marriage and raising children.

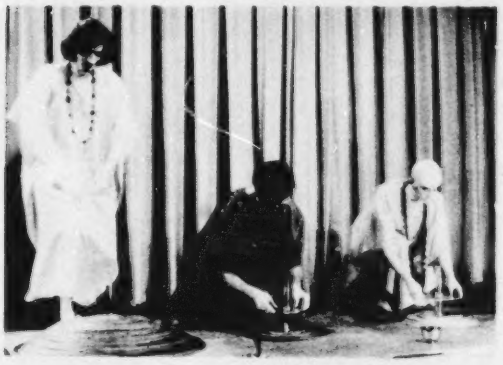
26-min. 16 mm Color Film or Videotape
25-0001 Purchase $245 Rental $25.

Women's Work: Management
Another in a series of documentaries encouraging women to consider careers in non-traditional fields. Women in various management roles share their experiences, role conflicts, aspirations, and satisfactions. Minority women, in particular, discuss their unique status in the management role.

29-min. 16 mm Color Film or Videotape
25-0002 Rental $27 Purchase*

Recursion
Visiting Professor Joseph Stoy explains and demonstrates the process of writing recursive programs, i.e. programs that invoke themselves. Detailed examples are illustrated (viz. three "monks" working on the Towers of Hanoi puzzle) and worked out to clarify this frequently misunderstood topic.

40-min. Color Videotape
14-0203 Purchase $330 Rental $33.



Demonstration of Sampling, Aliasing, and Frequency Response
Demonstration of sampling and aliasing with a sinusoidal signal. Sinusoidal response of a digital filter. Dependence of frequency response on sampling period. Periodic nature of the frequency response of a digital filter.

12-min. Color Videotape
22-0122 Purchase $120 Rental $20.

Measurement of Impulse Response
Demonstration of the relative invariance of linear time-invariant system responses to the detailed shape of a pulse input of short duration but fixed area.

11-min. B&W Videotape
13-0203 Purchase $80 Rental $20.

*Write for purchase price.

Fourier Series Demonstration
Approximation representation of a square wave by a sum of sine and cosine waves - even and odd functions, even and odd harmonics, Gibb's phenomenon, mean square error property.

15-min B&W Videotape
13-0208 Purchase $115 Rental $20.

A Visit with J. Th. G. Overbeek
The serious lecturer of the Colloid and Surface Chemistry series gives way to the warm human being behind the theories and demonstrations. In an interview with John T. Fitch of the MIT Center for Advanced Engineering Study, Theo Overbeek recounts his life story (beginning with his "firm decision" not to be a teacher!) including the development of the D.L.V.O. theory.

30-min. Color Videotape
11-0501 Purchase $210 Rental $21.

Energy for the Year 2000
A 1973 report by four MIT faculty members interviewed by John Fitch. The factors contributing to the energy crisis, a look at a computer model for predicting the effects of off-shore drilling, a visit to a cryogenic generator project and a discussion of energy alternatives for the future.

29-min. Color Videotape
25-0003 Purchase $265 Rental $27.

The Management of Technological Innovation

Seven Color Videotapes

For over a decade, the Alfred P. Sloan School of Management at MIT has carried out a broad research program on the effective management of research and development and on the commercial implementation of technological innovations. Six Sloan School faculty members report the status of that research in a late 1975 symposium for members of the MIT Industrial Liaison Program.

Motivating Scientists and Engineers
Professor Ralph Katz.
One of the major issues in every R&D setting. Recent research findings and contemporary views about motivation. Differences from classical perspectives and even from views popular in the '60s.

≈40-min. Color Videotape
25-0201 Purchase $200 Rental $50.

User Needs and Industrial Innovation
Professor Eric Von Hippel.
How to transfer an accurate understanding of user need to the manufacturer. User dominated, manufacturer dominated, and supplier dominated modes.

≈40-min. Color Videotape
25-0202 Purchase $200 Rental $50.

Technical Venture Strategies
Professor Edward B. Roberts.
Entrepreneurial alternatives: Investments in small companies, joint ventures and new venture spinoffs, and internal venture generation. Directions for enhancing new venture results.

≈40-min. Color Videotape
25-0203 Purchase $200 Rental $50.

Communication in Science and Technology
Professor Thomas J. Allen.
Technical problem-solving oriented communication at the organizational, inter-organizational, and national levels. Keeping the organization abreast of current technology and the most effective techniques for transferring technology.

≃40-min. Color Videotape
25-0204 Purchase $200 Rental $50.

Corporate /R&D Interface Management
Dr. William H. Gruber.
How performance of corporate /R&D divisions is determined by management policies and actions which affect the interface between R&D and the rest of the corporation. A strategy for improving performance.

≃40-min. Color Videotape
25-0205 Purchase $200 Rental $50.

Innovation in Industrial Organizations
Professor James Utterback, MIT Center for Policy Alternatives and Harvard Business School.
The changing relationship between product and production process technologies as a central factor in determining a firm's capabilities for innovation to meet changing competitive conditions. Variables which can be manipulated by corporate management, scientists, and engineers.

≃40-min. Color Videotape
25-0206 Purchase $200 Rental $50.

MANAGEMENT OF TECHNOLOGICAL INNOVATION - Complete Set

Those renting or purchasing the complete set of six color videotapes will receive - at no extra cost - a 40-minute question and answer session with all six speakers.

***Seven* Color Videotapes**
25-1200 Purchase $1200
30-Day Rental $300

Preparations for Experiments in Electrophysiology

Dissection of a Frog, Part 1: Sartorius Muscle - J.J. Guinan,Jr.
Demonstrates how to pith a frog and how to remove a muscle in a way which will make the muscle suitable for intercellular recording.

14-min. Color Videotape
25-0301 Purchase $140 Rental $20.

Dissection of a Frog, Part 2: Gastrocnemius Muscle and its Innervation - J.J. Guinan, Jr.
Demonstrates how to remove a gastrocnemius muscle and its innervation, extending from the muscle to the spinal cord.

17-min. Color Videotape
25-0302 Purchase $140 Rental $20.

Dissection of a Frog, Part 3: Sciatic Nerve - J.J. Guinan, Jr.
A method for dissecting out the main nerve trunk from the spinal cord to the ankle.

17-min. Color Videotape
25-0303 Purchase $170 Rental $20.

Electrophysiology of the Frog Heart - R.G. Mark
Dissection to expose beating heart of large pithed frog. Recording of ECG with Ag-AgCl electrodes. Use of suction electrodes to record electrical activity of various portions of heart. Correlation of these signals with observed mechanical behavior and ECG waveforms.

8-min. Color Videotape
25-0304 Purchase $100 Rental $20.

(Continued on inside back cover.)

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Massachusetts Institute of Technology
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Previews

Preview period is three (3) days. Film or tape must be returned immediately thereafter. Preview films and tapes are available only for prospective purchase.

Formats

All lectures and demonstrations listed in this catalog are available as videocassettes and videotapes. Many black-and-white (B&W) programs are also available as 16 mm films. Be sure to check the appropriate box in the order form to indicate the format you want.

Delivery

Please reserve films and videotapes at least two weeks before screening date to allow time for shipment. On complete set rentals, you may wish to suggest a screening schedule.

All shipments will be made by U.S. Postal Service, pre-paid and insured, F.O.B. destination, unless otherwise instructed. Shipment by other carriers are F.O.B. Cambridge, Massachusetts.

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